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Battelle Technical Review

IN THIS ISSUE: Nuclear Propulsion for Merchant Ships

VIGNETTE

E. E. McSweeney

The knowledge and abilities of the scientist and the engineer are the real heart of research. "Making the most of those qualities," states Battelle chemist E. E. McSweeney, "calls, of course, for the finest equipment and an atmosphere that enables researchers to give their best. Perhaps most important of all," he adds, "is creation of the kind of scientific freedom that encourages curiosity and interest in really significant problems. But such freedom, in turn, requires that research workers have the critical ability, in choosing their problems for study, to look beyond the specific study to the broader interests of society."

Mac arrived at the Institute in 1938, fresh from studies at the University of Rochester, with a Ph.D. degree in chemistry. First he turned his attention to organo-metallic materials, particularly the organo-tin compounds. Soon he was at work on polymers, with which much of his research has been identified.

His earliest polymer studies were concerned with petroleum resins and searches for uses of petroleum by-products. Research on polyethylene and other polymers followed. His third field of interest is associated with the chemistry and utilization of tall oil. Developments in these areas have been the basis for most of the 30 articles and papers Mac has authored.

Mac now oversees much of the Institute's chemical research. Typical of recent studies with which his colleagues have been concerned: development of new compound semiconductors; synthesis of new compounds of pharamaceutical interest; searches for new uses for a host of materials, including the rare earths, molybdenum chemicals, bark chemicals, and selenium; development of growth-control chemicals, insecticides, and other agricultural chemicals; the chemistry of high-temperature lubricants; and evaluation of the cancer-curative properties of selected chemicals.

As manager of Battelle's Department of Chemistry, Mac has encouraged his colleagues to pursue research reflecting their own interest. Among these have been probings into the fundamentals of organic semiconductors, the creation of synthetic compounds to aid studies of mental illness, the correlation of structures of polymers with their useful properties, and the investigation of the techniques of molecular distillation.

Mac's professional interests have been broad and continuous. Currently he is a member of the Council of the American Chemical Society, representing the Organic Coatings and Plastics Division of which he was formerly chairman. He is also a member of the Research Committee of the Federation of Societies for Paint Technology and is active in the American Society for Testing Materials, the Society of Plastic Engineers, and the Society of the Chemical Industry (British).

A graduate of Oberlin College, Mac has served recently as president of his alma mater's alumni association. Another interest is his work in the Big Brothers organization. Between times, with his wife, Joy, he relaxes at home with their three daughters, Martha, Ann, and Mary, and son Michael. Construction projects around home are his prime recreation, he says.

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Abstracts of articles and papers in a wide variety of technological fields from more than 1350 journals published throughout the world. Abstract selection largely reflects primary areas of Battelle research.

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Technological Advance and Economic Stability

It must be apparent to everyone that the high standard of living the people of the United States enjoy, and the country's position of economic leadership, depend upon our workers operating an industrial mechanism as elaborate, sophisticated, and effective as any the world has seen. Per capita use of electric power in the United States, for example, shows that its workers possess highly efficient means to produce the wealth that enriches the entire population.

This elementary economic fact--tha the average standard of living is determined by the productivity of the workers increased by technical means—makes it apparent that technological advance is a good thing for the economy and for the average citizen, *provided it is utilized to increase production*. For the United States, as for any nation, highly skilled labor and technical sophistication are the only really effective means for meeting economic competition and maintaining the highest possible standard of living.

The principal cause of failure to utilize technical knowledge to the fullest extent is the economic dislocation that may arise out of a technological change. Industry may be reluctant to scrap obsolete plants because of plant investment. Or labor may resist an otherwise desirable technological change because of a temporary adverse effect on a particular group of workers.

In a competitive society, such as that of the United States, fortunately, there is a strong motivation for an industry to keep up to date in its operations. The pressure of competition acts effectively to force companies to maintain their technical operations at as high efficiency as possible. If they do not, they suffer in comparison with other companies. They cannot afford to retain nonprofitable obsolescent plants.

The effects of technological change on labor are not so simple. Nor are the problems associated with change so easy to solve. It is not so obvious that improvements in our economy benefiting many outweigh adverse effects on a few. The economic dislocations involve human adjustments that cannot be ignored. Technological unemployment becomes a haunting fear in the minds of people who may be involved in a change in the operating routine of an industry.

Fear of technological unemployment is perhaps a greater obstacle to technical progress than unemployment itself. Nations which enjoy a high degree of labor mobility and adaptability are fortunate. These characteristics are important factors in competitive relations with other economies. The receptiveness of workers to the learning of new skills is a critical element in adapting a nation to technical change.

The real income of workers of all countries is determined by the output of the tools they have to work with. This is an impelling reason for a nation to improve the level of its technical skills in every field. The principal fear of foreign competition is that it will somehow reduce the real income of a nation's own people. If this comes about, the reason is more likely to be in a nation's failure to maintain technical competence than from degradation of the working standards of labor in other parts of the world.

B. D. Thomas, President, Battelle Memorial Institute, based on a statement prepared for the Subcommittee on Automation and Energy Sources of the Joint Economic Committee of the Congress of the United States.

Nuclear Propulsion for Merchant Ships*

Nuclear propulsion for ships is technically feasible. The author discusses the problems involved in making it economically practicable for merchant ships.

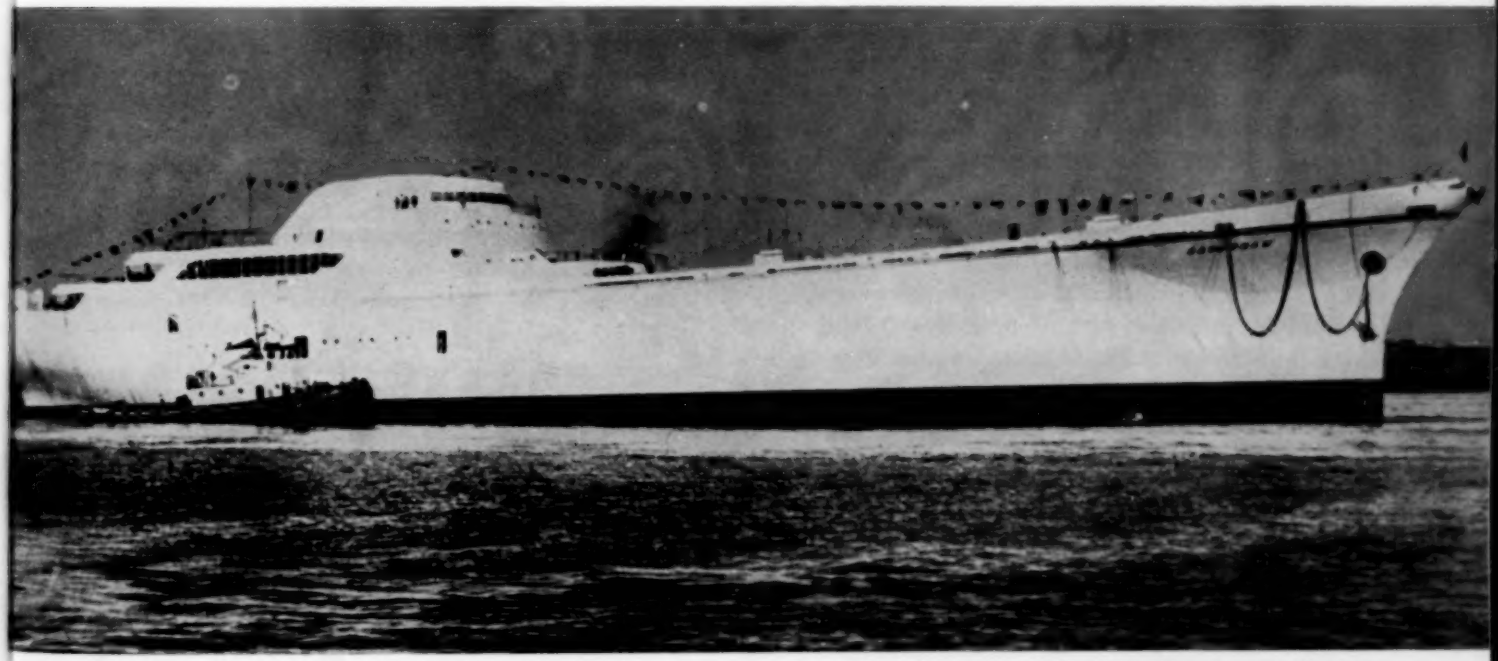
by SHERWOOD L. FAWCETT

THE USE OF NUCLEAR ENERGY in mechant-ship propulsion is receiving much attention from the leading maritime nations. The United States, with completion of the NSS Savannah and with development of an advanced gas-cooled reactor plant for use in ships in progress, has the most advanced program. Japan, the United Kingdom, Norway, France, Italy, the Netherlands, and Sweden have programs in the study and planning stage, but have not yet begun building nuclear ships. However, some construction programs appear likely within the next several years. In West Germany, a grant of about $4 million has been announced for an organic-moderated reactor soon to be installed in a tanker, the *ESSO Bolivar* (15,256 dead weight tons).

The success of the United States nuclear submarines and the USSR icebreaker *Lenin* has proved that nuclear power is technically feasible for ships. Their use has shown that when power cost is not the primary consideration, reactors can be designed for ships of conventional size and can be built, operated, and maintained without undue radiological hazards and with high reliability.

Reactors that are technically satisfactory and economically competitive with conventional power are still to be developed for merchant ships. Before nuclear energy can compete in this field, reactors will be needed that require less highly enriched uranium and that can be constructed of cheaper materials by less

*This article is based upon information which first appeared in one section of "The Applications of Atomic Energy Other than Central-Station Power Generation", a special report prepared at Battelle for the Congressional Joint Committee on Atomic Energy. The discussion presents the current and prospective technical state of the art, outlines known research in progress, discusses nonnuclear means of attaining the same objectives, and probes the economic implications involved in the use of nuclear energy in the particular situation. Since the original report was based on an exploratory survey rather than exhaustive studies of each potential application, this digest, of course, cannot be expected to be the last words on the subject.



The 22,000-ton Nuclear Ship Savannah, first nuclear merchant ship afloat. It will be able to travel 350,000 miles on a single fuel loading. The ship, which will serve as a floating laboratory to provide data for future nuclear ships, can carry 10,000 tons of cargo and 60 passengers at a 21-knot speed. (Photo courtesy The Babcock & Wilcox Company)

costly methods. Such basic changes of reactor design will reopen the question of technical feasibility. They could affect reactor maintenance and reliability and the hazards of operation.

The Economics of Nuclear Merchant Ships

United States. A comprehensive study of economics of nuclear merchant ships as it might apply to the U. S. Merchant Marine has been conducted for the USAEC. The study compared nuclear and conventionally powered ocean-going mechant ships for cost per unit carried and for return on investment for the period 1957-1970. Estimates were based on existing ships and on proposed ships with known characteristics. Four reactor types were used in the analysis: pressurized-water, boiling water, organic-moderated, and closed-cycle gas-cooled. The comparisons of capital and operating costs were determined for these ships as they might operate at various trade route distances and speeds.

Organic-moderated and boiling-water reactors seem most likely to be the first to become economically competitive with conventional maritime power plants. Of the ships, ore carriers, tankers and general-cargo ships, in that order, appear to have the greatest economic potential for nuclear propulsion. Passenger and passenger-cargo vessels are least promising. The longer the distances and the higher the speed, the more competitive are nuclear with conventionally-powered ships.

Other Countries. Studies of the economics of nuclear merchant ships have been made also by British, German, Norwegian, and Japanese authors. Although differing in some details, their findings are in general agreement with those of the United States study.

A somewhat different approach was taken by the Japanese, who considered a ship to carry Japanese emigrants to South America. They designed a vessel to best utilize nuclear power. It was then compared with a smaller conventional ship presumably optimized for its power plant. Voyages, size, and speed were thus chosen in each case to find the lowest costs for each power plant. On this basis, over 20 years, the nuclear-powered vessel gave an average profit on capital of 17 per cent while the conventional ship averaged 34 per cent. The authors concluded that both types of vessel are economically profitable.

Evaluation of Economic Information

With the exception of the Japanese emigrant-ship study discussed above, all of the economic studies reviewed performed economic comparisons by substituting a nuclear for a conventional plant in the same ship plying the same trade routes. Under these conditions, the variable parameters are essentially speed and size. Important differences in power plants are fuel weight, fuel inventory cost, insurance rates, and labor.

The table below shows the chief differences between the two systems. On the basis of the statements, it appears that nuclear power will be most economic under conditions that yield the most ton-miles per day. Such conditions seem to call for:

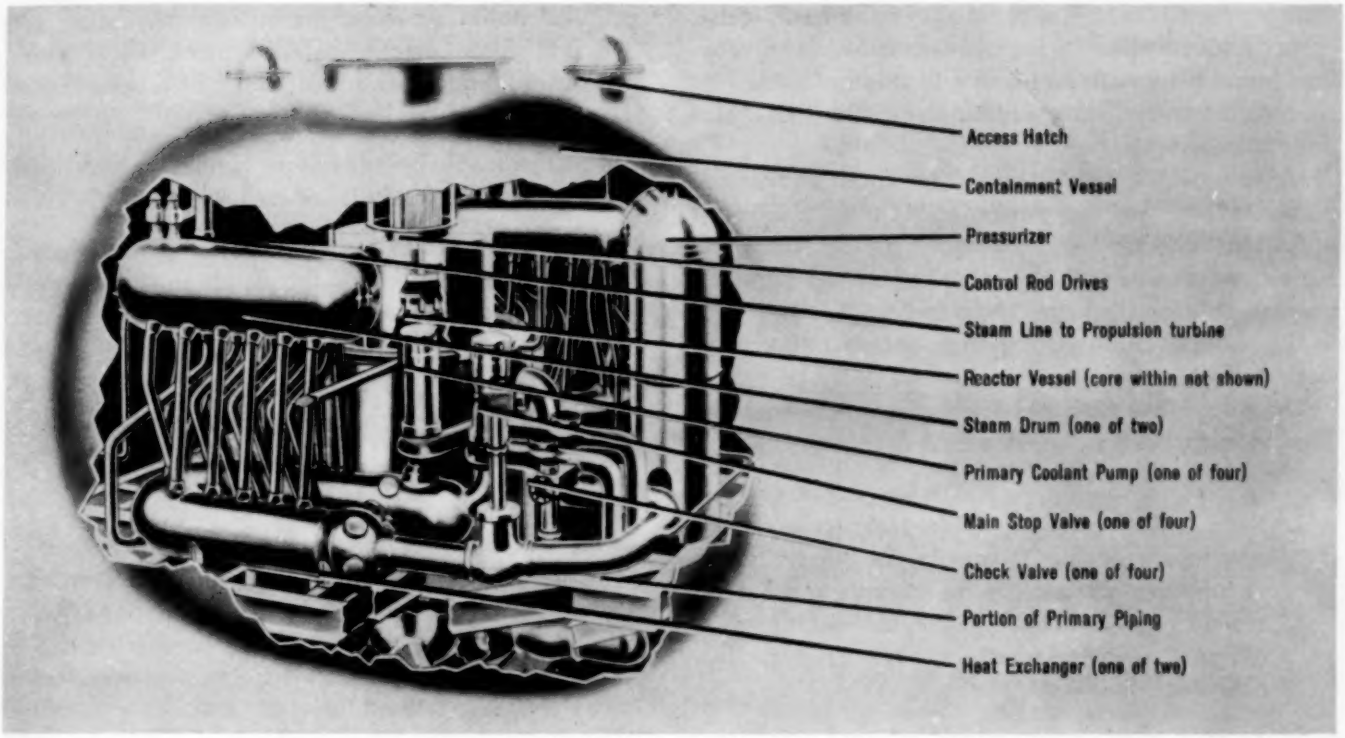
1. Large, fast ships (The capital cost of reactors goes up less rapidly than their size. Thus, increasing the reactor size by a factor of 5, increases its cost by only about 2.5 times).
2. Long voyages (to increase the duty cycle).
3. Bulk cargoes (to minimize time in port, which also increases the duty cycle. Also, conventional fuel in this case takes up cargo space.).

The large role of amortization charges in the cost structure favors reactor types with the lowest capital cost. Hence, the organic-moderated is likely to be preferred over the boiling- or pressurized-water and gas-cooled reactor types, because of the lower cost of its primary system components.

Hazards and Insurance Rates. The hazards to life and property of a nuclear-powered merchant fleet are

EVALUATION OF AVAILABLE INFORMATION

	Conventional	Nuclear
Fixed costs per day	80 to 90% of total cost of operation	
Amortization as part of daily costs	45 to 60% of total daily costs (of all but passenger and passenger-cargo ships)	30 to 40% greater than conventional power
Other daily fixed costs	Wages on tankers, ore carriers and general cargo ships 15%; passenger and passenger-cargo 30-35%	7 to 10% greater than conventional power
Insurance	10-13%	60 to 100% greater than conventional power
Nuclear fuel inventory	.....	3 to 8%
Fuel costs	Largest daily item	About equal to or less than conventional fuel costs, depending on assumptions used in arriving at nuclear fuel costs


Access Hatch
Containment Vessel
Pressurizer
Control Rod Drives
Steam Line to Propulsion turbine
Reactor Vessel (core within not shown)
Steam Drum (one of two)
Primary Coolant Pump (one of four)
Main Stop Valve (one of four)
Check Valve (one of four)
Portion of Primary Piping
Heat Exchanger (one of two)

Sketch of the Savannah's *pressurized-water reactor. With a power of 69 megawatts, the reactor can develop 22,000 horsepower at the shaft.* (Illustration courtesy The Babcock & Wilcox Company)

greater than for land-based plants and will be reflected in liability insurance costs. Risks of serious reactor accidents in land-based reactor plants have been reduced to an acceptable level through careful design of safety features, reactor containment, and remote location. The designers of ship reactors face a far more difficult problem: Their reactors will not be in remote locations, and there are hazards not present in land-based units.

For example, a reactor is subject to many risks incident to the ship's operation, including vibration, heavy-weather motion, fire, cargo explosion, collision, flooding, capsizing, or grounding. Between 2 and 3 per cent of vessels over 500 tons have been damaged by collision and fire each year. It is logical to conclude that nuclear vessels will be involved in serious accidents, too. These factors suggest two aspects that are unique and vital to the acceptance of nuclear power in the merchant marine of the world:

1. The probability of damage to nuclear power plants from causes external to the reactor system is high. Reactor design must minimize the consequences of damage from external causes. Since this requirement will be reflected in the capital cost of the ship and its plant, it may dominate the choice of reactor types.
2. Liability insurance rates for nuclear-powered ships must be very carefully derived in estimating the comparative economics.

Here is the reason for concern over the latter point: The American Standard Study reported that in 1957 the insurance rates for conventionally-powered ships were estimated to be about 10 per cent of the daily fixed costs. Comparative rates for nuclear-powered ships were estimated as 60 to 100 per cent greater. However, the bases for the increased premiums for the nuclear-powered ships were: (a) the increased capital cost and (b) the highest liability premium established by The Nuclear Energy Liability Insurance Association for land-based central-station nuclear power plants. Owing to the high probability of damage in marine installations, it is questionable whether the liability rates for land-based plants apply. Since insurance premiums are roughly proportional to the product of the probability of an accident during the premium period and the liability that might be incurred, marine rates are likely to be considerably higher than such estimates. If so, insurance may dominate the economics of nuclear-powered ships.

Research and Development Needs. In many ways the problems of developing reactor power plants for ships are similar to those for land-based central-

station power plants. Hence, much of the basic technology is identical, and advancements in technology for land-based plants can be utilized in reactors for ships. In both cases reducing capital-plant and fuel-cycle costs is important.

Marine reactor installations differ from land-based plants in size, reactor power level, weight, layout, operating schedule, and hazards. Hence, cores of higher enrichment and somewhat different control requirements are called for. These factors, however, are in the realm of engineering design criteria rather than basic technology.

The areas of research and development needs unique to marine application, where available information appears inadequate, are as follows:

1. Risks and consequent liability of nuclear-powered merchant ships to provide realistic estimates of insurance rates. Since the hazards of different reactor types are not the same, the variations for different reactors must be considered in the analyses.

2. Reactor plant layout, shielding, and shipboard location for most economic operation. Included might be studies to:
   a. Find and develop materials that could best serve a dual role of shielding and of minimizing the effect of external damage.
   b. Determine and find ways to minimize the effect of externally caused damage to the reactor core.
   c. Provide sound estimates of the effects of release of radioactivity under conditions of serious ship damage and/or sinking.
   d. Determine the comparative safety of reactor type (boiling water, pressurized water, organic cooled, etc.) during accidents or shipping.
   e. Determine the effect of reactor type on accessibility for maintenance.

3. Ship types that will best utilize nuclear power plants. Studies of this kind might be expected to lead to considerable cost reduction for nuclear ships in the near future. On this subject the American Standard study reports "Since the size and cost of the reactor plant increase slowly as compared to the power output required, sea speeds in excess of those presently specified may be economically desirable. Very large, full, and very fast ships may be designed to have maximum stability and still be more economic. . . . To maintain high sea speeds, sea-keeping characteristics must be maximized, permitting full utilization of the installed plant. In addition, cargo discharge and loading must be accelerated to warrant the high ship speeds."

4. Advanced nuclear ship *systems* which fully utilize the capability of nuclear power.

Much of the thinking about and study of nuclear ships has been based upon the simple substitution of a nuclear for an oil-fired plant in a more-or-less conventional hull. Economic comparisons are then made for trade routes, ship sizes, speed ranges, in-port time, etc., of current marine practice.

This practice, developed over the years for a merchant-marine industry using oil-fired power plants, is unlikely to fit the needs of nuclear-powered ships. Indeed, using current practice as a basis for evaluating nuclear-powered ships would be somewhat like fixing the value of modern oil-fired ships on the basis of sailing-ship practice. Studies of advanced ship systems to make the most of nuclear marine power would seem to be seriously needed.

To illustrate the type of thinking this approach might entail, consider a sea-train concept, either surface or submarine. The nuclear-powered "locomotive unit" stays at sea almost continuously, picking up already loaded "trains" and towing them to ports (but not into harbors). This type of operation would increase the duty cycle and minimize liability insurance premiums. Furthermore, under these conditions the lowest cost per ton-mile might well turn out to be relatively independent of length of trade route, speed, and size of vessels in the train. If this were the case, the range of economical operation of nuclear power might be increased.

The economy of nuclear-powered ships may be greatly dependent upon totally new concepts developed in other technologies. Thus, some recent developments by the U. S. Rubber Company suggest that it may ultimately be possible to greatly reduce the drag of submerged vessels, though not of surface

Sherwood Fawcett guides important nuclear research at Battelle. He and his colleagues have conducted studies leading to the development of unusual in-pile loops for reactors, investigations of reactor fuel-element and structural-component designs, and evaluations of reactor concepts. He has participated in research on the Enrico Fermi Breeder Reactor, and the Submarine Thermal Reactor. During the past decade he has also had an important role in the design and establishment of the Institute's nuclear facilities.

vessels. Such a development might greatly improve the potential for a cargo-carrying or—towing submarine, which would almost certainly depend upon nuclear power for propulsion.

Prospects for International Cooperation

It is the general consensus of published reports that the prospects for economic operation of nuclear ships are definitely encouraging. Owing to the uncertainties in cost estimates, however, the prospects of economic operation within the next 10 years vary with the optimism of the analysts. Whether for reasons of realism or national pride, the idea of nuclear-powered merchant ships has aroused the interest of the maritime nations of the world. It is obvious that the United States has done more than any other nation in conducting programs that will contribute significantly to evaluating the prospects for a nuclearized merchant marine.

On technical and economic grounds it appears that U. S. development efforts will continue to supply the data needed for an ultimate evaluation of this application of atomic energy. As discussed above, the considerable effort devoted to achieving economic central-station power in this country is largely applicable to economic nuclear ship operation. Moreover, the knowledge gained through the naval ship program is certainly applicable to the merchant marine. Thus communication of this country's integrated experience to other countries could help immeasurably in their efforts to apply nuclear power to their merchant marines.

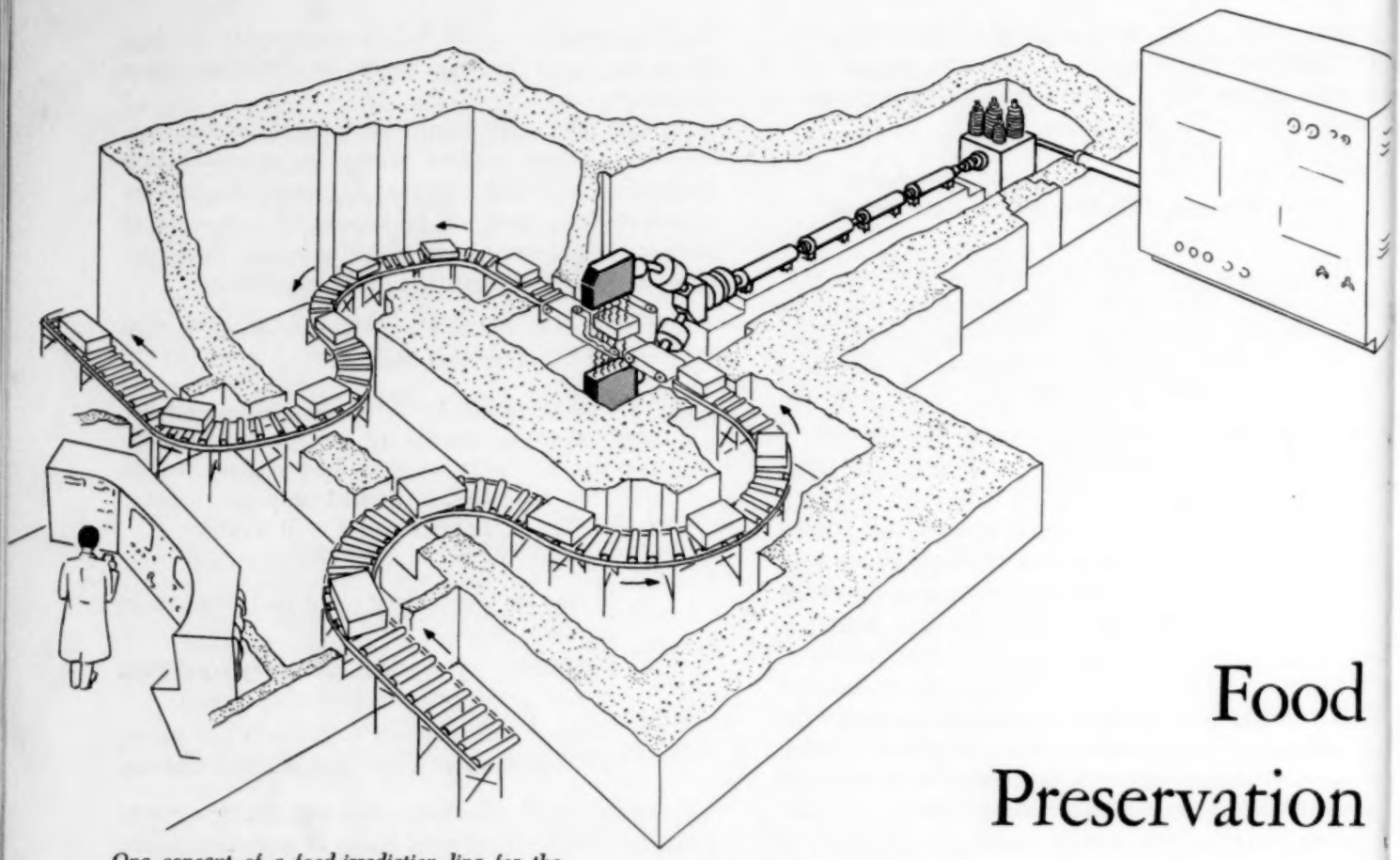
At some time in the future—assuming that economic ways of utilizing nuclear energy for merchant-ship propulsion are found, and that large-scale application is undertaken—there will be a need for a number of nuclear fueling stations at strategic points. Such stations might have the following characteristics:

1. Location in sparsely populated areas to reduce the effects of nuclear hazards.
2. Provide all of the facilities for loading and unloading cores, repairs to reactor systems, inspection of the primary coolant system, etc., in addition to fulfilling normal ship-maintenance needs. These facilities might well include:
   a. Hot cells for inspection of spent fuel
   b. Means for transferring spent fuel elements to shipping casks
   c. Equipment for checking criticality conditions of new cores prior to power operation
   d. Trained technologists to perform the necessary functions in a safe and efficient manner.

Construction of refueling stations of this type might be considered by the United States at some time in the future. If made available at an appropriate time, such stations might do much to encourage other countries to obtain and operate nuclear-powered merchant vessels.

"I am strongly of the opinion that it is the scientist's mission not only to uncover nature but also to interpret his results to his fellow men. Scientific knowledge is itself neutral. It is the use that is made of it that is good or evil. Decisions concerning that use are not for the scientist alone. The layman must therefore make his own efforts at understanding. To assist him, the scientist must, in turn, be ready to leave his laboratory to act as a guide."

Sir Edward V. Appleton in *Science*



One concept of a food-irradiation line for the proposed U.S. Army Ionizing Radiation Center. Utilizing a linear accelerator, the equipment is designed to irradiate food cartons from above and below as they move on the conveyor.

Food Preservation by Ionizing Radiation*

How much can we expect from radiation as a method of food preservation? The author assesses both the effectiveness and cost of this method as compared with conventional techniques.

by HARLAN W. NELSON

BECAUSE INDIVIDUAL CLASSES OF foods differ in their requirements for preservation, a number of methods have been developed over the years involving one or a combination of procedures such as dehydration, fermentation, salting, chemical treatment, canning, refrigeration, and freezing. The basic objectives in each instance are to make available supplies of food during the intervals between harvesting or slaughter, to minimize losses resulting from the action of microorganisms and insects, and to make it possible to transport foods from the area of harvest or production to areas of consumption.

In earlier years, the preservation of food was essentially related to survival. In the more sophisticated atmosphere of today's developed nations, food-preservation techniques have sought also to bring variety, peak freshness, and optimum taste and flavor in foods at reasonable cost to the comsumer.

With the development of nuclear technology, isotopic materials, and machine radiation sources in recent years, the possibilities of applying ionizing radiation to the preservation of foods attracted the attention of investigators in the United States and throughout the world. An early hope that irradiation might be the ultimate answer to practically all food-preservation problems was soon dispelled. Interest re-

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mained, however, in the possibility that it would serve as a useful supplementary method for counteracting spoilage losses and for preserving some foods at lower over-all costs than freezing, or without employing heat or chemicals with their attendant taste alterations.

Factors Responsible for the Spoilage of Foods

The chief factors responsible for the spoilage of fresh foodstuffs are (1) microorganisms such as bacteria, molds, and yeasts, (2) enzymes, (3) insects, (4) sprouting, and (5) chemical reactions. Microorganisms are often responsible for the rapid spoilage of foods. Of special concern is the growth of bacteria such as *Clostridium botulinum* which generate poisonous products. Enzymatic action in stored food produces changes which can adversely affect the appearance of food or its palatability. Spoilage by chemical action results from the reaction of one group of components in the food with others or with its environment, as in corrosion of the walls of metal containers or the reaction of fats with oxygen in the air to produce rancidity.

Sprouting is a naturally occurring phenomenon in stored potatoes, onions, carrots, beets, and similar root vegetables. Insect infestation is a problem of importance chiefly in stored grain. The presence of parasitic organisms such as *Trichinella spiralis* in pork introduces another factor which must be dealt with in food processing.

To permit the storage of food for long periods of time, a method of preservation must accomplish the destruction of microorganisms and inhibition of enzymatic action. The term "sterilization" applies to methods involving essentially complete destruction of all microorganisms. Foods treated in this manner and protected from recontamination by aseptic methods of packaging and containment presumably could be stored for long periods without refrigeration. The process of "pasteurization" involves milder and less prolonged heat treatment which accomplishes the destruction of most, but not all, of the microorganisms. Less severe thermal treatment as by blanching or scalding serves to inactivate enzymes.

General Effects of Ionizing Radiation

Ionizing radiation can cause the destruction of microorganisms and insects involved in food spoilage or, at lower doses, can inhibit their action. It furnishes a means of destroying insects in stored grain products as well as certain parasitic organisms present in meats. Deactivation of enzymes is also possible, although some types require extremely heavy doses of 10 Mrad* or more. Because of undesirable flavors, odors, colors, and generally low palatability associated with radiation treatment of this magnitude, the inactivation of enzymes is best accomplished prior to irradiation by the conventional heat-processing methods of blanching.

Radiation does not retard the chemical spoilage of food. It will, however, inhibit the sprouting of potatoes and other root vegetables.

The radiation doses required for the preservation of foods are in the following ranges:

1. For radiosterilization, to destroy all organisms for long-term preservation—about 4.5 Mrad for nonacid foods of low salt content.
2. For radiopasteurization, to partially destroy microorganisms; results vary with types of food, storage conditions, and objectives of treatment—commonly of the order of 0.2 Mrads but up to about 0.8 Mrads.
3. For destruction of insects—about 25,000 rads.
4. For inhibiting the sprouting of root vegetables—4,000 to 10,000 rads.

Preserving foods with ionizing radiation leads to some undesirable side effects, particularly at the higher radiation dosages. In this respect, the general palatability and individual acceptance of most radiosterilized foods has, to date, been found to be low in comparison with fresh and commercially processed foods. A number of foods are quite acceptable as regards taste and palatability, however, at dosages substantially less than sterilization levels. Moreover, the nutritive value of irradiated foods apparently undergoes little, if any, change, although some of the fat-soluble vitamins are affected by sterilization doses.

Radiation Sources

For irradiation of food, the results obtained depend upon the dose rather than the specific type of radiation, and X-ray, gamma, and high-energy electron radiation are suitable. Aside from availability and economic considerations, each has certain practical advantages; for example, gamma rays give deeper penetration but cannot be focused or collimated, whereas unidirectional electron beams may be split and directed to both the top and bottom of the food package to be

*A rad is the unit signifying the energy absorbed from ionizing radiation by a unit mass of irradiated material, and is equal to 100 ergs per gram. A Mrad is one million rads. In terms of engineering units, 1 rad is equivalent to 1.26×10^{-6} watt-hours per pound.

irradiated. Selection of a source for commercial irradiation would involve consideration of numerous factors including required dose rate, load factor, throughput, convenience, safety, and most important, costs.

Of the potentially useful sources of ionizing radiations, gamma sources, cobalt-60, cesium-137, fission products, or a reactor irradiation loop system using a material such as an indium salt have received most attention for food-preservation systems. Of the various particle accelerators, the Van de Graff machines, resonant transformers, and linear accelerators are the principal ones available for commercial use.

Costs of the effective energy produced by these sources is a major obstacle in the development of food-preservation processes. Estimated production costs of radiation energy from machine and nuclide sources range from $1 to $10 per kwhr. Conventional energy for processing foods is available in the range of at most a few cents per kwhr for electric power and the equivalent of a few mills per kwhr for process steam. Radiation, therefore, is at an initial cost disadvantage even though only 1 to 10 per cent as much radiation energy as heat energy is required for radiopasteurization or radiosterilization. What are the possibilities of lowered radiation production costs for the future? It has been estimated that for applications on a megawatt scale costs might reach values in the neighborhood of 10 cents per kwhr for large-scale accelerators or for gamma radiation generated in a reactor core. No comparable reductions in the cost of nuclide radiation are foreseen. Such projections, however, appear highly speculative and the capacities involved are far beyond those foreseen for food-preservation facilities.

Because agricultural activities are seasonal and the areas of production and harvest of many foods are widely scattered geographically, and because of the high cost of transporting bulk food items any substantial distance to a central processing location, the use of large central processing stations, where low-cost radiation facilities approaching the megawatt range might be utilized, is inherently impracticable.

COMPARATIVE COSTS OF CANNING, FREEZING, AND IRRADIATING MEAT[a]

Cost Elements	Irradiating Costs[b], cents/lb				Thermal[c] Costs, cents/lb (Standard Retorts)	Freezing[c] Costs, cents/lb (Plate Freezers)
	Electron Accelerator		Cesium 137			
	10^5 rad	3 M rad	10^5 rad	3 M rad		
Raw material Preparation for processing	Same for all processes					
Processing	0.33	0.87	0.62	4.89	0.16	0.32
Packaging	2.19	2.48	2.19	2.48	2.48	2.19
Transportation[d]	1.95	1.50	1.95	1.50	1.50	2.10
Storage[e]	0.39	0.12	0.39	0.12	0.12	0.42
Total	4.86	4.97	5.15	8.99	4.26	5.03

(a) Production basis. In all cases, 43,200,000 lb are produced per year. Thermal and freezing costs are based on an 8-hour day, 300 days per year. Irradiation costs are based on 9000 lb processed per hour, 16 hours per day, 300 days per year.

(b) The costs of radiation processing are based on the following costs per kilowatt-hour emitted from the source.
- a. 2.26-kilowatt electron accelerator (10^5 rad dose): $11.40.
- b. 68 kilowatt electron accelerator (3 M rad dose): $ 0.95.
- c. 2.26 kilowatt cesium 137 source (10^5 rad dose): $19.15.
- d. 68 kilowatt cesium 137 source (3 M rad dose): $ 6.30.

Source power levels are established by assuming a 50% absorption efficiency in all cases.

In addition to these costs, in all cases a cost of 0.14 cent per pound (separately estimated) was added to cover nonsource direct labor and overhead and amortization of the building and conveyor system.

(c) Thermal and freezing costs were obtained from producers in the field.

(d) Cost of transportation is from Chicago to San Francisco.

(e) Storage costs are estimated for private facilities.

Source: *Radiation, A Tool for Industry*, Report ALI-52, Office of Technical Services, Department of Commerce (1959).

Present Status of Irradiation Preservation of Foods

The objective of complete sterilization of foods is to produce a wholesome and palatable product capable of being stored without refrigeration for extended periods of time. Chief interest in radiosterilization resides in the military services. For them, providing appetizing food under battle or emergency conditions is a paramount consideration. They require completely sterile foods capable of being stored without refrigeration, preferably items already cooked and ready to eat. High nutritional value, variety, palatability, and appetizing appearance are important for reasons of morale. Foods for rear stations, which require cooking, but no refrigeration, are also of interest. Of primary interest are meats.

Radiopasteurization, which produces fewer adverse sensory changes in food products, has potential usefulness in prolonging the keeping qualities of fresh and refrigerated food items. Thus, food so processed might reach more remote markets and permit the consumer to enjoy more produce at peak freshness and palatability. Commercial interest is chiefly in this type of treatment, as is military interest under peacetime conditions.

The present status of food preservation by ionizing radiation is discussed by food classes in the following paragraphs.

Meats

The radiation processing of meat has received extensive investigation. To date, the one meat showing favorable results at sterilization doses is pork. Of particular interest to the military services is the demonstration that roast pork, after radiosterilization, is superior in palatability to available canned pork products. Tests with beef have been largely unsuccessful because of the development of off-flavors. A prime objective of the Army Quartermaster Corps program is to find the reasons for beef's low palatability and means of overcoming it, since it is a major and desirable dietary item. Partly because low-level heat treatment is needed to inactivate enzymes before radiosterilization, treated fresh meats have the appearance of boiled or canned meat.

Off-flavor is a less severe problem with the radiopasteurization of meats, but problems of commercial acceptability remain. Moderate radiation doses of from 100,000 to 200,000 rads can extend the shelf life (at 35 F) of fresh beef from 5 days to 5 or 6 weeks. However, the problem of consumer acceptability remains. The preradiation blanching process discolors the treated beef and liquid accumulates in prepackaged cuts. Cooked beef irradiated in the absence of oxygen assumes an unnatural pink color.

When lamb and mutton are irradiated at substerilization doses, the meat becomes dehydrated, the fat become chalky, and, again, unnatural changes in color occur.

Ground meats such as fresh pork sausage and hamburger have a relatively short shelf life under refrigeration, and radiopasteurization might be thought to offer distinctly improved keeping qualities. However, a major problem here is one of scale of processing; ground meats are usually prepared from scrap meats at the local level, whereas irradiation at economic volumes of production would require central processing and distribution facilities. The problems of color change by blanching and liquid accumulation within the package are the same as for solid cuts.

Specialty cooked items containing meat portions, as in "frozen dinners" might offer a potential use for radiopasteurization. The principal potential advantage would be that the finished product could be transported and stored at lower cost under refrigeration instead of being frozen. A refrigerated item could also be heated and served in less time than is required for frozen foods of the same type.

Competitive processes for preserving meats are by canning and freezing. Costs of canning meat are in the range of 0.8 to 5 cents per pound; costs of freezing are in the area of 2 to 3.5 cents per pound. The table on page 10 shows costs of canning and freezing meat, and estimated costs for irradiation under certain assumed conditions. Under the conditions of comparison, it will be noted that:

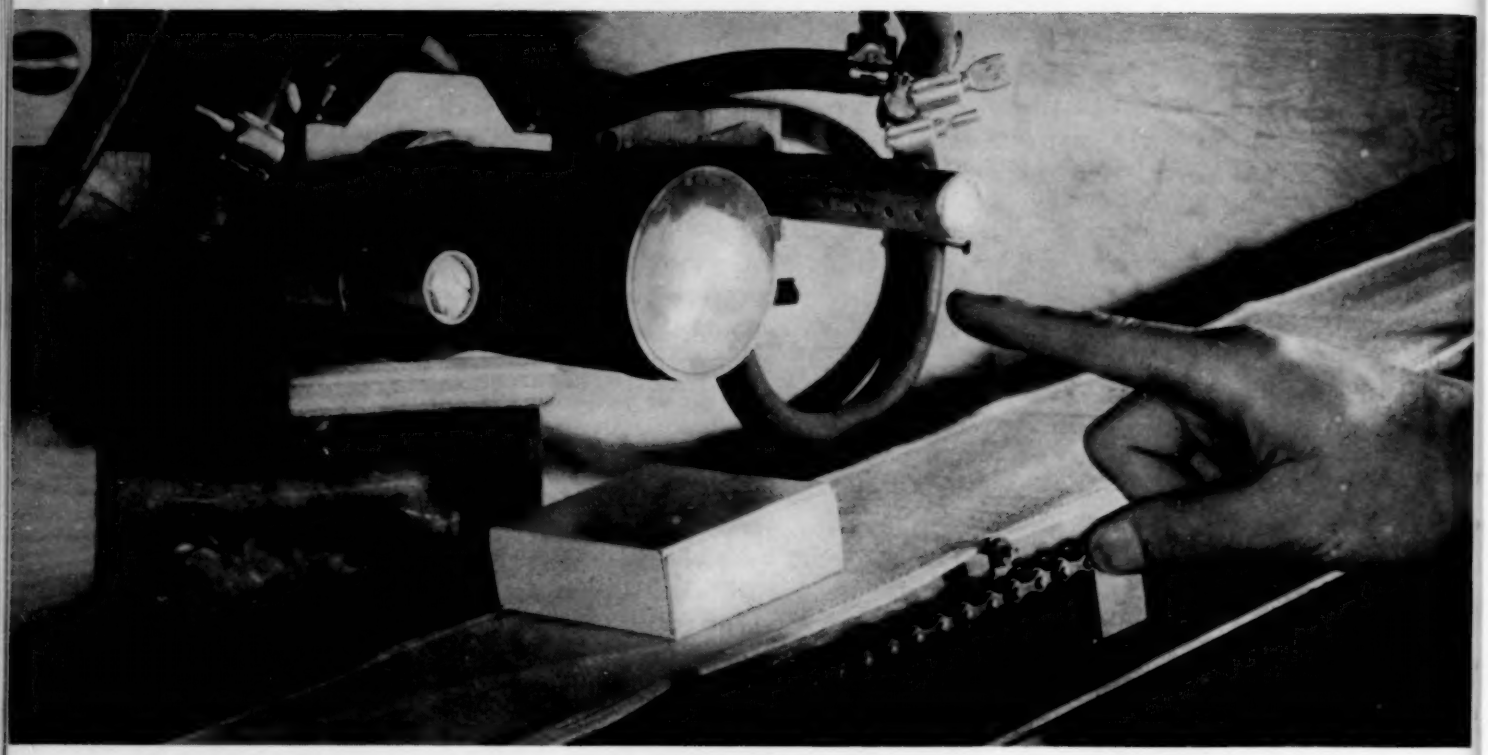
(1) Radiosterilization (at 3 Mrad) is more expensive than canning, particularly for the cesium-137 source.

(2) Radiopasteurization by either the electron accelerator or cesium-137 source is in the range of freezing costs.

(3) Irradiation using the nuclide source is more expensive than use of an electron accelerator.

Poultry

Results of irradiation tests with poultry have been quite successful. At sterilizing doses, good palatability results, with a minimum of changes in appearance, taste, and odor. Radiopasteurization has also been successful, and the shelf life of chicken can be extended to a month or more under refrigerated storage as compared with about 10 days for the untreated product. Acceptable taste and odor are retained by the



Experimental equipment used in the soft X-radiation of cheese, specialty meats, fruits, vegetables, and other foods. The X-ray tube provided about 2,500,000 rads per minute at the treating surface. At pasteurization doses, the storage life of bacon and cheese was at least doubled without significantly affecting flavor and odor.

irradiated and refrigerated chicken. Acceptance of radiopasteurization is likely to be delayed, however, for two reasons: (1) the storage life of fresh chicken under refrigeration is becoming a minimal problem because of constantly improved sanitation and distributing practices, and (2) treatment by antibiotics, a measure already approved by the Federal Food and Drug Administration, serves to extend the storage life of chicken at a low cost of about 0.5 cent per pound.

Seafood

Fresh seafood products are extremely perishable. Although refrigeration has served to extend the storage life of these products, substantially increased consumption might be possible if areas remote from the seacoast could be served adequately. Radiopasteurization has been found to extend the refrigerated shelf life of a number of seafoods by a factor of four. Tests have shown that such items as cod, halibut, ocean perch, shrimp, crabmeat, oysters, and lobster retain characteristics believed to be acceptable to the consumer. Palatability after irradiation at sterilization doses is more questionable, although acceptable results have been reported for oysters, shrimp, codfish cakes, tuna and others. A competitive process for most seafood products is freezing, which results in highly acceptable and palatable products that can be distributed to distant markets.

Vegetables

Little commercial interest exists in the radiosterilization treatment of vegetables. Changes in characteristics commonly occur. At substerilization levels of treatment, fair results have been obtained with vegetables such as carrots and asparagus, but it is not possible to generalize. For most vegetables, factors of texture and taste associated with garden-fresh produce are of extreme importance. Provided a high degree of palatability can be demonstrated, the interest in vegetable irradiation would be in reduction of spoilage of fresh produce at costs competitive with those for freezing, and perhaps to increase the time vegetables can be held at processing plants after harvesting to add to the time available for conventional processing. Again, however, the logistics of gathering produce for an irradiation installation large enough to be economic under seasonal conditions appear unfavorable.

Fruits

Some varieties of cherries, grapes, strawberries, blueberries, peaches, and citrus fruits irradiated at low pasteurization doses to inhibit stem rot and formation

of surface molds, have shown fair to good product acceptability. Since irradiation at low doses has been shown to kill the larva of various fruit flies, it is also possible that more extensive marketing of tropical fruits such as papayas might be feasible.

Until more facts are known about the economics of radiopasteurization plus refrigeration as compared with freezing techniques, it is impossible to estimate the commercial feasibility of irradiation methods. Seasonal harvesting and logistic considerations again present formidable economic problems.

Inhibition of Sprouting

Small doses of radiation of the order of 10,000 rads have been shown to extend the storage life of potatoes, onions, sweet potatoes, beets, and carrots by preventing sprouting. No significant changes in flavor accompany the irradiation. One drawback experienced with potatoes has been the increased susceptibility to bruising and the development of black rot.

Although technically feasible, the economics of treating by radiation to prevent sprouting are questionable. Treatment costs must be low, perhaps of the order of a fraction of a mill per pound, and methods of chemical treatment and controlled ambient atmospheres may show economic superiority since substantial capital costs are not involved.

Grain Disinfestation

Because insects destroy an estimated $250 million worth of stored grain annually, disinfestation by irradiation has been considered. The operation appears to be technically feasible; and radiation doses in the favorable range of 10,000 to 30,000 rads have been found sufficient for disinfestation.

Economics, however, seem to put irradiation processes at a disadvantage. In the first place, estimates of costs of irradiaton by electron generators, 0.35 to 2.3 cents per bushel, are higher than costs for chemical fumigation, 0.2 to 0.6 cents per bushel. Moreover, the fact that storage losses are higher (about 10 per cent) for farm structures than for central storage silos (1 to 2 per cent) limits possibilities for use of irradiation. Small-scale irradiation units such as might be useful for serving farm and other dispersed storage facilities are least economic. Larger sources in fixed locations would have low load factors with resultant higher costs. Larger-scale units at central mills cannot now compete with very low-cost fumigation costs where infestation losses are smallest, in any case.

Milk

Irradiation of milk and other dairy products is accompanied by pronounced and undesirable changes in flavor and color. The problems of milk irradiation include formation of a tallowy off-flavor, development of a brown color and a carmelization flavor on storage, and a tendency to flocculate. Since fresh pasteurized milk can be obtained throughout most of this country and since acceptable grades of dry milk solids are available, there appears to be little, if any, incentive for commercial irradiation in this area.

Wholesomeness of Irradiated Foods

Whatever the technical feasibility and economics of processes for the irradiation of foods for human consumption, the factor of wholesomeness is of overriding significance. The term "wholesomeness" covers both the nutritive quality and factors of potential toxicity of food products. Under the 1958 Food Additive Amendment of Federal Public Law No. 85-929, the burden of proving the safety of any food process or chemical additive is placed directly upon the processor or manufacturer.

Because of the interest of the military services, a comprehensive program for evaluating the wholesomeness of irradiated foods has been conducted under auspices of the Department of Defense. The Office of the Surgeon General, U. S. Army, in particular, has been conducting a test program since 1953; and over 30 different research groups, including university scientists, research foundations, and Government laboratories have participated in making the studies. Commercial food-processing companies have been interested in the results and have cooperated in the program to the extent possible. The Army wholesomeness assay program has been carried on with the full cooperation of the Food and Drug Administration, particularly in regard to research procedures and techniques. Proving the wholesomeness of irradiated foods is complicated by the necessity of assaying each individual food, or a number of each class and type, both at sterilization doses and below. Until the wholesomeness of irradiated foods is proven beyond dispute, there can be no possibility of commercialization of the process for supplying either the military or civilian market.

Nutritive Value

From tests made to date, principally with animals, irradiative treatment appears to have little effect upon the nutritive value of the carbohydrates, fats, and proteins present in foods. Small differences in biological value, digestibility, or energy content have been observed in some irradiated foods, but not to a degree

sufficient to affect the nutritional value of mixed diets. This result applies as well to foods that have been stored for some time after irradiation.

Irradiation does, however, have a marked effect on the vitamin content of foods. The water-soluble vitamins are sensitive to ionizing radiation in varying degrees; niacin is the least, and thiamine the most sensitive. The destructive effect is greater for vitamins in aqueous solution than for those in foods, and the effect on a given vitamin varies with different foods. The extent of destruction by irradiation at sterilization doses is similar to the losses of vitamins produced by heat processing, but the destructive effect on vitamins might be compounded when irradiated foods are subsequently cooked. For diets employing irradiated foods at sterilization doses, supplementary water-soluble vitamins probably would be required. However, it is generally believed that a mixed diet of irradiated and raw natural foods would introduce an adequate amount of the vitamins under conditions of the average household. This necessity would not, however, enhance the acceptance by the housewife of irradiated foods.

The fat-soluble vitamins, A, E, and K, are more sensitive to ionizing radiation than are the water-soluble ones and are easily destroyed. Impairment of reproductive capacity (from lack of E) and of bleeding in animals (from lack of K) have resulted from the feeding of irradiated foods. Supplements of vitamins E and K overcome both problems. Bleeding tendencies observed with rats fed irradiated meats, does not necessarily extend to humans under the same conditions; human Vitamin K requirements or the significance of the intestinal micropopulation in satisfying Vitamin K needs are not known. There are no indications from animal tests to date that growth, life span, lactation, or reproductive capacity are significantly changed by consumption of irradiated foods if the diet included adequate supplementary vitamins.

Toxicity

Problems of bleeding and other effects observed in animals, might properly have been discussed here. However, these effects are probably classified more properly as nutritional deficiencies rather than as effects induced by the synthesis of toxic substances during or following the irradiation process. With one possible exception, rupture of the auricle of the heart observed in mice, the consensus appears to be that tests on humans and animals to date have shown few, if any, indications of toxicity of irradiated foods. Evidence on the heart-rupture problem is somewhat conflicting. Additional tests should determine if the rupture results from toxicity of irradiated foods or is an associated nutritional problem.

Induced Radiation

Experimental evidence indicates that gamma, X-ray, and electron beam sources of relatively low energy do not induce activity in foods in detectable amounts. Gamma or electron-beam radiation having energies of the order of 10 Mev and above, however, can induce radioactivity and produce radioactive isotopes from elements in foods.

The hazard of induced radiation from either gamma or electron sources having energies below 2.2 Mev is minute or nonexistent. Indeed, the detection and evaluation of the induced radioactive effect of, and assay of the biological hazard from, minute amounts of radiation is a difficult task. Yet, the cumulative effect of the intake of even these minute amounts must be evaluated by biological methods so as leave no doubt that their effect on man is infinitesimal and beyond hazard. Quite aside from legal and regulatory aspects, the consumer is unlikely to be satisfied by anything less than proof of the complete absence of any conceivable adverse effect from irradiated foods.

Current Research Programs

Studies of food preservation by ionizing radiation have been conducted by many organizations—universities, private research laboratories, industrial, and governmental. The greatest effort, however, has been put forth by the Department of Defense.

The contribution of commercial food processors was considerable for several years. Prior to 1959, 14 companies surveyed had supported total annual radiation research of $1 million. Thereafter, their activity was curtailed to await the outcome of pending Department of Defense investigations.

Aside from the "wholesomeness program" of the office of the Surgeon General, the U. S. Army's Quartermaster Corps had plans for a general research program centered around a Food Irradiation Facility to be constructed at Sharpe General Depot in California. The Center was to have a 3000-pounds-per-hour pilot plant with a 2.2 megacurie cobalt-60 source and a 24-Mev linear accelerator for irradiation purposes. It was to be large enough to evaluate technical operating problems and process economics and to supply food for large-scale tests on humans.

Plans for the Center were suspended on October 22, 1959. The Army's reasons: unresolved questions about tests on animals made the venture premature; and lack

of economic justification for a large-scale facility in view of insufficient detailed proof of the economic and logistic advantage of food irradiation for the military. In a revised program, the Army decided to concern itself largely with the radiosterilization of foods of military interest.

Industry and a number of departments of the Government questioned whether the suspension of plans for an irradiation food-preservation center coincided with broad national interest. As a result, an Interdepartment Committee was formed to consider the advisability of a complementary program directed to possible civilian interest in food preservation by radiation. Eventually, on the basis of a report from an *ad hoc* panel, the Commitee in January, 1960, made recommendations for a national civilian radiation-processed foods program designed to determine the effect of low-dose irradiation on extending the shelf life of foods in the normal channels of commerce. A 6-year study was scheduled to be carried on under the direction of the Atomic Energy Commission. In the meantime, a new program largely concerned with the radiosterilization of foods of military interest was announced by the Army, and work was resumed on the construction of the linear accelerator. A smaller food irradiation center will be built at a site as yet unselected.

The United States has been the leader in research on the radiation processing of foods. Other countries, however, have shown considerable interest in the program; and some, as facilities become available, have initiated programs of studies of their own. The international interest in radiation processing was evident at the International Conference on The Preservation of Foods by Ionizing Radiations, which was held in Cambridge, Massachusetts, July 27-30, 1959. Delegates from 22 nations throughout the world presented papers on radiation-processing activities in their countries and participated in discussions outlining their needs and potential applications for specific food products.

Studies on the radiation preservation of foods were reported under way in England, Canada, Australia, Poland, Germany, France, and Japan. Studies are also known to be in progress in Russia. India, Brazil, Portugal, South Africa, and Argentina reported organizational plans for specific studies. Obviously, however, the smaller and less developed countries, for whom the needs for improved food-preservation and distribution methods may be most pressing, look to the initiative, guidance, and development of irradiation methods from the United States and other of the more industrially advanced nations.

Incentives for Commercialization

Clearly, research is necessary in a number of areas before food irradiation can be adjudged: economic in comparison with conventional preservation methods; completely safe with respect to the potential toxicity of the irradiated product; and most important, acceptable to the consuming public in terms of cost, palatability, and general acceptance. The consumer will be the final judge once such foods have been approved by the Federal Food and Drug Administration.

The consumer's acceptance of irradiated foods will be based primarily on quality and cost, assuming that his fears of radiation have been allayed. If improvement in quality is too slight to be an important factor, only the commercial advantages of irradiation will serve to encourage its use. The latter might include: longer marketing periods for fresh or fresh-like products; new markets for such products in more remote areas; and less spoilage of products that are irradiated.

Commercially, over-all economics will dictate how and if radiation will finally be used. At its present stage of development, irradiation is of only marginal interest to the food industry. Therefore, any major research and development is likely to be under governmental sponsorship. Yet in view of the potentials of the process that have already been revealed, further research seems desirable.

Long concerned with research on fuels, Harlan Nelson is currently associated with economic and utilization studies in the field. In recent years, he has directed much of his effort to the economics of nuclear energy, including its possible value in the field of power generation and potential uses in other industrial applications. Another area of continuing interest for him is that of the high-energy fuels now so important in aviation and space travel. Over the years, Nelson has been associated with technological research in such fields as coal gasification and utilization, combustion phenomena, and combustion equipment development.

Writings by STAFF Members

The Diffusion of Radioactive Fission Products From Porous Fuel Elements. Setphen D. Beck. U.S. Atomic Energy Commission, *BMI-1433*, Apr. 18, 1960, 25 pp. (UF767 U3b Contin.) (OTS $1.00).

The release of fission products from porous fuel elements during irradiation may be largely a diffusion process. An equivalent-sphere hypothesis has been proposed to provide a model by which the diffusion can be analyzed. The equations of diffusion have been previously solved for in-pile conditions. The slow convergence of the formulas makes the previous solutions awkward. In the present investigation alternate formulas were derived which are more suitable under certain circumstances. Tables have been prepared from which release rates and accumulations may be evaluated for prescribed conditions. The application of the analysis to the interpretation of release data is explained.

Mescaline Analogs. X. 3,4-Dimethyl-, 3,4-Dichloro-, and 3,5-Dimethoxy-4-methyl-β-phenethylamines. F. Benington, R. D. Morin, and Leland C. Clark, Jr. *Journal of Organic Chemistry*, v. 25, No. 1960, p. 2066-2067.

In a study of the influence of ring substituents on β-phenethylamines on psychopharmacological activity, three new β-phenethylamines substituted in the 3-, 4-, or 5-positions of the ring were synthesized, and the effect of these compounds on normal cat behavior was examined.

Synthesis of Some Vicinal Trimethoxyphenyl Derivatives of Heterocyclic Nitrogen Bases. F. Benington, R. D. Morin, and L. C. Clark, Jr. *Journal of Organic Chemistry*, v. 25, Nov. 1960, p. 1912-1916.

A number of vicinal trimethoxy analogs of compounds possessing the psychopharmacological activity were synthesized to examine the influence of vicinal trimethoxy groups on this type of activity.

The Absorption and Effusion of Hydrogen in Alpha Iron. D. C. Carmichael, J. R. Hornaday, A. E. Morris, and N. A. Parlee. *American Institute of Mining, Metallurgical, and Petroleum Engineers, Transactions, Metallurgical Society*, v. 218, no. 5, Oct. 1960, p. 826-832.

Rates of absorption and effusion of hydrogen in solid Fe were measured by a Sieverts type of apparatus. With clean α-iron these rates are diffusion controlled down to 420 C and are represented by the equation $D = 6.70 \times 10^{-4}\ e^{-1100/T°K}\ cm^2\ sec^{-1}$. Certain surface impurities can affect these rates at all temperatures. Thin oxide films lower the apparent diffusivity as annealed iron markedly. Cold-worked iron (75%) annealed at 430 C has practically the same solubility and diffusivity as annealed iron.

Battelle Memorial Institute. Winston Duckworth. *Ceramic Age*, v. 76, no. 4, Oct. 1960, p. 27-32.

Discusses present status of ceramic investigations at Battelle and describes facilities available for conducting research.

Electroshaping: New Process Speeds Metal Removal. C. L. Faust and C. A. Snavely. *Iron Age*, v. 186, no. 18, Nov. 3, 1960, p. 77-80.

The new process differs from others which use the electrolytic metal removal principle. Electroshaping uses electrical energy to dislodge the surface atoms of the metal. They are swept away by a rapid and controlled flow of a chemical solution. Thus, an atom-by-atom process replaces chip-by-chip removal. Materials that are being shaped include stainless steels, hot-work tool steels, W, and Mo.

Tracking Missiles at Night by Light Flashes. Alexander Finlay, Robert E. DeMuth, and William D. Hall. *Electronics*, v. 33, no. 46, Nov. 11, 1960, p. 88-89.

Precisely timed, high intensity light flashes from beacon in missile permit trajectories to be determined from distances to 400 miles.

Hydrogen Embrittlement of Cadmium Plated Spring Steel. J. A. Gurklis, L. D. McGraw, and C. L. Faust. *Plating*, v. 47, Oct. 1960, p. 1146-1154.

Reports results of research to determine optimum processing and plating procedures to minimize H embrittlement in plated steel springs. The data support the conclusion that Cd plating does not measurably embrittle spring steel and disclose a safe cleaning and etching procedure. Harmful preplating treatments are described along with an effective baking procedure to relieve embrittlement. The slight sensitivity of spring steel to delay fracture and fatigue failure, and the efficacy of several test methods for H embrittlement are established.

Welded Fabrication of Steel Solid-Propellant Rocket-Motor Cases. M. D. Randall, R. E. Monroe, and P. J. Rieppel. PB 161 206 *DMIC Memorandum* 56, May 31, 1960, pp. 28.

The development of solid-propellant rockets has suddenly increased the use of thin sections of high-strength steels. Solid-propellant rocket-motor cases must be lightweight and at the same time must withstand high internal pressures at fast loading rates. Welding currently provides the most efficient fabrication techniques for the production of light, high-strength cases. The successful production of these cases requires extensive welding fabrication know-how. The high percentage of failures of rocket-motor cases during hydrotesting attests to the need for better welding-fabrication techniques.

Flue Dust, Slag, Mill Wastes and Their Industrial Utilization. (*In German.*) Flugasche, Schmelzschlacke, Müllschlacke und ihre industrielle Verwertung. Rudolf Rasch. *Chemiker-Zeitung/Chemische Apparatur*, v. 84, no. 17, September 5, 1960, pp. 564; no. 18, September 20, 1960, pp. 595-598.

Waste utilization was studied from the technical and economic viewpoint. Use of brown coal ashes presents difficulties due to S content. Ordinary coal ashes can be used as additions to cement, due to pozzolana-like qualities. Material for construction can be prepared from screened ashes and slag granules bonded by cement. Phosphate fertilizer can be obtained from slag. Due to low volume, unsuitable compositions and high water contents, much remains to be done regarding the further use of slimes from coal and ore mining, and metallurgical plants. The all over picture can be improved by combining different types of wastes.

The Effect of Nuclear Radiation on Semiconductor Materials. F. J. Reid, J. W. Moody, and R. K. Willardson. PB 147 101; *REIC Report No.* 1, December 20, 1957, pp. 48. (LC Mi $3.30 ph $7.80)

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A literature survey is presented on radiation effects in semiconductor materials. Results indicate that Ge is relatively radiation resistant. From 1 to 30 ohm-cm Ge the minority-carrier lifetime and the conductivity begin to be affected at about 10^{11} fastneutrons/sq cm. Less pure Ge ($<$ 1 ohm-cm) gives greater radiation resistance. Si appears to be less radiation resistant than Ge by as much as a factor of 2.

Prediction of Creep Failure Time for Pressure Vessels. F. P. J. Rimrott, Earl J. Mills, and Joseph Marin. *ASME, Transactions, Series E, Journal of Applied Mechanics*, v. 27, no. 2, June, 1960, pp. 303-308.

The creep-failure time for a thick-walled pressure vessel is defined as the time at which the true creep strain reaches infinity. It is then shown that the creep-failure defined in this manner can be used to predict the time-to-fracture of a vessel. The solution is presented in the form of graphs. Simplified formulas for creep-failure time were obtained for both thin-walled cylinders and very thick-walled cylinders. These latter results appear as asymptotes to the curves for the exact solution of the thick-walled cylinder.

Investigation of the Properties of Tantalum and Its Alloys. Frank F. Schmidt and William D. Klopp, et al. PB 161 758, U. S. Air Force, Wright Air Development Division, *WADD Technical Report 59-13*, March, 1960, pp. 112. (OTS $2.50)

The reactions of unalloyed tantalum with air, N, and O were studied. Vacuum sintering of high-purity and high-impurity-content Ta powders was investigated to determine the ocnditions required for purification. The effects of alloying on the oxidation behavior of tantalum were determined. Several alloying elements were found to be effective in reducing both scaling and contamination. Interstitials were studied for their effects on mechanical behavior at low and elevated temperatures. Screening studies were conducted on the effects of substitutional alloying on mechanical properties at room tempearture and at 2200 F.

Carbon-Film Resistor Failure Rates, Task 31. Final Report on Component Evaluation and Specification Engineering. C. A. Shearer, Hall Cary, H. Braner, and J. L. Easterday. UB 1338 882; October 18, 1957, pp. 51. (LC mi $3.60, ph $9.30)

Describes a load-life failure-rate program for ½-watt carbon-film resistors as well as the performance characteristics of this type of resistor after being subject to several sequences of environmental conditions. Two thousand resistors from four different manufacturers were evaluated. The tests show that there is a marked difference in characteristics of deposited carbon-film resistors, and that the borocarbon-film resistors are inferior to the deposited carbon-film types for extended operational load life.

Relationship Between Isothermal and Anisothermal Nucleation Characteristics of Austenite Decomposition Products. C. R. Simcoe, A. R. Elsea, and G. K. Manning. U. S. Air Force, Wright Air Development Center, *WADC Technical Report* 54-303, PB 130 378; September, 1954, pp. 34. LC mi $3.00, ph $6.30)

A study of the additivity of fractional nucleation times indicates that the temperature ranges of addivity are not the same for all steel compositions. Knowing the temperature ranges of additivity, the time and temperature for transformation to start for various cooling rates was calculated by using the Scheil hypothesis.

Investigation of Behavior of NaOH-UO_3 Slurries in Small Flow Loops. J. H. Stang, J. F. Lagedrost, E. M. Simons, and R. W. Dayton. U. S. Atomic Energy Commission, *BMI-867*, September 15, 1953, pp. 30. (OTS $0.50)

Dynamic tests in all-nickel loops indicated that, at 1000 F, slurries could be circulated and thermally cycled successfully for long periods of time in a properly designed flow system. This is based primarily on favorable indications of stability at 1000 F even though all slurries handled exhibited rapid settling characteristics in the static system of a special apparatus designed to measure settling rates. However, at 1400 F, continued circulation would not be possible because of a tendency of the slurry to deposit on walls in the cooler parts of the system.

Tax Exemption and Research. B. D. Thomas. *Science*, v. 131, March 18, 1960, pp. 876 + 1.

The newly proposed regulations for the tax treatment of scientific research raise fundamental questions regarding the freedom heretofore enjoyed of pursuing scientific research in the interest of increasing scientific knowledge, regardless of who sponsors the research.

Experimental Gastric Ulcer and Effect of a New Anti-Ulcerous Drug, Chlorbenzoxamine. C. Radouco-Thomas, C. Lataste-Dorolle, C. Rogg-Effron, G. Voluter, M. Meyer, J. M. Chaumontet, and D. Larue. *Arzneimittel-Forschung (Drug Research)*, August, 1960, pp. 563-698.

Chlorbenzoxamine seems to act as a protective agent against the devitalization of mucosa subsequent to the intraparietal vasomotor disturbances induced by acute and subacute ulcerigenic processes. Histological evidence shows that the administration of chlorbenozxamine, in those ulcers in which little inflammation and sclerosis can be observed, stimulates the formation of healing epithelial and granulation tissues.

Studies Relating to Hydrogen in Dingot Uranium. Max J. Trzeciak and Manley W. Mallett. U. S. Atomic Energy Commission, *BMI-1225*, September 20, 1957, pp. 32. (OTS $0.65)

Hydrogen in dingot U causes difficulties in further processing and in end use. As a part of the efforts to eliminate this problem, a study was made of the distribution of H among feed materials and products in the thermite reaction producing dingot U. The possibility of removing H from U by degassing at elevated temperatures and at low pressures was considered. Calculations were made for the diffusion of H in U rod. Several cases were chosen to illustrate the potentialities of this technique.

Particle Impacts on the Melt Layer of an Ablating Body. E. W. Ungar. *ARS Journal*, v. 30, September, 1960, pp. 799-805.

An equation is developed relating the increase in erosion rate, as a result of particle impacts, to flight and material parameters. The extent of the melt layer protection was found to be rependent on the particle size and melt layer thickness. One experimental check on the analysis was possible by inspection of the order of magnitude of the experimental liquid melt layer thickness on fired Micarta specimens. The computed melt layer thickness agreed with that observed on glass-reinforced Micarta 259-2 test specimens which were exposed in a rocket exhaust jet.

Studies of Methods of Sealing Ends of Reactor Fuel Rods for PWR. J. J. Vagi and D. C. Martin. *Welding Journal*, v. 39, October, 1960, pp. 443s-448s.

As part of the WAPD program for developing fuel rods for PWR, methods for sealing the ends of Zircaloy 2-clad, U-12 w/o Mo-cored fuel rods made by coextrusion were investigated. Attempts were made to join Zircaloy 2 end plugs to the rod by means of pressure bonding, resistance welding and fusion welding. Exploratory tests indicated that resistance upset welding was promising. Tension-test fractures occurred in the Zircaloy 2 end cap away from the weld joint when materials were vacuum terated prior to upset welding. Percussion welding and flash welding were eliminated from extensive consideration because molten core alloy was extruded out along the cladding-to-end bond line when these processes were used. Attempts to fusion weld an overlay on the ends of the fuel rods resulted in nd seals that had U at the surface and also contained gas porosity.

Standard Designations of Alloys for Aircraft and Missiles: Trade Names, Aeronautical and Military Specifications and Producers of Stainless Steels, Alloy Steels, and Superalloys. J. J. Vagi. PB 161 192. *DMIC Memorandum* 42, January 25, 1960, pp. 68. (OTS $0.50)

Tabulates compositions, manufacturers, standards, and military, AISI, SAE, and ASTM designations.

Fundamental Studies of Ultrasonic Welding. N. E. Weare, J. N. Antonevich, and R. E. Monroe. *Welding Journal*, v. 39, August, 1960, pp. 331s-341s.

Studies were made to determine the mechanism of bonding, the effects of welding variables, and the effects of material factors. After preliminary experiments indicated the importance of heat generated at the weld interface, apparently from a simple friction reaction, a simple weld joint was used for further studies of the mechanism of bonding.

NOTES from BATTELLE

✱ SPHEROIDIZING METAL POWDERS

Spherical metal powders are frequently required for such purposes as filters or transpiration-cooled parts. Currently such powders are obtained largely by separation from atomized or shotted powders.

In research for the Federal-Mogul Division of Federal-Mogul-Power Bearings, Inc., Battelle metallurgists explored a spheroidization process described in U.S. Patent 2,038,251. Basically, the technique involves the free fall of metal powders through a hot zone. The zone must be sufficiently hot and long enough to allow particles to melt and for surface-tension forces to reshape them into spheres before cooling. Subsequent fall through a cool zone should last long enough to permit their solidification.

Marshall J. Wahll, John R. Van Orsdel, and Roland B. Fischer, who describe the investigation, found that a rather short hot zone was sufficient to melt free-falling metal powders of various particle sizes. Heating zones used in the experimental equipment included the following sizes and temperatures: 3-inch diameter, 15-inch length, 1900 C; 2½-inch diameter, 24-inch length, 1650 C; and ¾-inch diameter, 13-inch length, 3000 + C. This laboratory apparatus was suitable for spheroidizing only small quantities of powders. Scale-up studies have not yet been made.

The metallurgists found the process particularly advantageous because particle size can be controlled by using sized starting powders. Moreover, high-melting-point materials can be spheroidized. Bronze, aluminum, electrolytic copper, titanium, molybdenum, and tungsten-carbide spherical powders were produced in addition to stainless steel.

✱ COATED-PARTICLE NUCLEAR FUEL

The U. S. Atomic Energy Commission has assigned to Battelle, under an existing Commission contract, a three-year research program on the "Coated-Particle Nuclear Fuel Concept". The objective of this extensive program is to develop coated particles with high temperature properties, fission product retention capability, and good neutron economy. This program will provide much of the fundamental information required in support of the over-all Commission effort on coated particles.

In the "coated-particle" process, small grains of the fissionable nuclear fuel compound—comparable in size to common table salt—are coated individually with a dense, refractory material that will both protect the fuel from damage by chemical reaction at the high temperatures of the nuclear reactor and prevent escape of the troublesome radioactive by-products formed in the fuel by the fission process. Both carbon and alumina coatings have worked well in early studies conducted at Battelle in work related to the Pebble Bed Reactor concept. Coated fuel particles are evenly dispersed, like gravel in concrete, in a material (such as graphite) that can be conveniently shaped into reactor fuel elements by mass production methods. Such fuel appears particularly attractive for high temperature operation because only ceramic materials are utilized.

In contrast, present fuel elements are temperature limited by metallic cladding. In addition, good neutron economy can be expected from coated particle fuels.

Because there is considerable industrial interest in the "coated-particle" nuclear fuel concept, the program also provides for the evaluation of commercially produced coated particles. Interested manufacturers should contact Dr. R. W. Dayton at Battelle for information about this evaluation program.

✱ DETERMINING FUEL BURNUP

Techniques now in general use for determining burnup distribution (the amount of U-235 atoms fissioned) in a fuel element are subject to many disadvantages, and they are likely to be grossly inaccurate. An improved approach to the problem has been developed at Battelle. It is based upon the combining of the relative gamma activity of a fuel element with the results of burnup analysis to obtain a relatively accurate contour of the fuel burnup in the fuel element.

As described by Richard J. Burian, John E. Gates, and Duane N. Sunderman, the method involves making energy sweeps of the element to determine the areas to be scanned more closely. Based upon data gained from scanning, slugs are punched from the fuel plates for burnup analysis by standard radiochemical techniques. The burnups are then related to the radioactivity of the various slugs, and the gamma activity

scan curve is converted to burnup values. By obtaining burnup contours for several fuel plates in a fuel-element assembly, burnup contours in three dimensions may be established for the assembly.

According to the Institute technologists, the method provides at relatively low cost valuable information on neutron flux distribution in the core of the reactor as well as on fuel-element burnup. So effective is the method, they report, that even the nuclear effect of structural material or other poisons in the reactor core can be evaluated.

✻ PROPERTIES OF TUNGSTEN SHEET

Advanced propulsion systems create a continuing demand for structural materials that will stand up under increasingly extreme temperatures. Because of their high melting point and elevated-temperature strength, tungsten and its alloys are naturally of interest as possible materials for use in this area. Heretofore, data have been available on these materials in wire form. Recently, Battelle metallurgists Benjamin C. Allen, Daniel J. Maykuth, and Robert I. Jaffee studied the properties of tungsten in sheet form for the U. S. Air Force Special Weapons Center at Kirtland Air Force Base.

The lack of low-temperature ductility is the primary problem in use of tungsten. In their study, the metallurgists sought data on how the metal is affected by trace impurities and intentionally dispersed additions of inert materials. They wanted to learn how fabricability, recrystallization behavior, and ductile-brittle transition are affected as a step to increasing tungsten's low-temperature ductility as a sheet material.

Briefly, the research provided the following information. Study with high-purity tungsten fabricated from single crystals revealed that 40 ppm of oxygen or 1 ppm of hydrogen have little effect on recrystallization temperature, but 100 to 200 ppm of carbon tends to raise it from 1200 to 1300 C. Moreover, 10 ppm of trace metallic impurities appear to have greater effect on recrystallization temperature than do interstitial impurities. Tungsten single crystals were very ductile at room temperature. Introduction of grain boundaries by mechanical working and annealing, however, raised the bend-transition temperature to 320 C.

Addition of certain refractory oxides, nitrides, or carbides raises the recrystallization temperature of powder-metallurgy tungsten from 1600 to 1800 C. The bend ductile-brittle transition temperature is lowered from 230 to 150 C for wrought and from 420 to 330 C for recrystallized tungsten when 2 volume per cent of zirconia or thoria plus sodium oxide are added. Thus it was found feasible to improve both elevated-temperature properties and low-temperature ductility of tungsten by dispersion alloying.

✻ STUDY OF ALASKA'S FUTURE

More and better roads in Alaska and Northwest Canada will be an important factor in the economic growth of that area, a recently completed Battelle study for the Alaska International Rail and Highway Commission indicates. In a preview of the study presented to the Commission last month, the gist of the report given was: The area's annual income may well increase by almost $1.4 billion in 20 years, and selected highway construction projects costing an estimated $240 million will be an important factor in this predicted income increase.

For residents of the area covered by the study, perhaps the most significant part of the report was the section recommending five major highway improvement and construction projects for a more integrated road system. The primary basis for all of these recommendations is tourism, which the study indicates is the principal economic-development potential in the area that would benefit substantially from new or improved land-transport links. All of the highway improvements recommended could be financed over a twenty-year period from the estimated additional revenue that would be generated by an integrated road system. Estimated yearly maintenance cost of such a system would be more than offset by increased revenue from gasoline taxes.

Petroleum production and tourism, according to the study, are likely to contribute most to increased income to the Alaska-Northwest Canada area in the next twenty years. In the case of projected oil production, as with all other minerals considered in the study, Battelle specialists have based their projections mainly on known deposits only. Nonetheless, they expect the annual value of petroleum produced in the area by 1980 to increase by more than $400 million, with the Canadian part of the area claiming a large share of the increase. Their estimate, as well as all other dollar estimates in the study, is based on actual or assumed 1960 price levels.

Tourism runs a close second for increased income to the area, with the study projecting increased spending by travelers at about $380 million annually by 1980, assuming that more and better roads, public transportation, accommodations, and services are provided. If effectively promoted, this economic asset

seems to be one of the strongest to the Battelle specialists, who have traveled throughout the area in making their study. In twenty years, they foresee a potential of 850,000 travelers annually to Alaska and an additional 550,000 to northwest Canada.

The area's forests also are rated as a top income maker during the coming 20 years. The increase in value of forest products has been estimated to be almost $300 million annually by 1980.

Major new metal and mineral (other than fuels) production—the great lure for new settlers in the Goldrush Era—has a less certain future. Based on known deposits, the report estimates a possible increase in value of metals and minerals produced at about $155 million annually by 1980, including many highly conjectural developments.

Commercial fishing—long a mainstay of the economy of northwestern North America—will certainly remain an important income maker for the area during the next 20 years, despite recent low levels of production. There are many "if's" involving conservation and international law, but the study indicates that increase in the value of the fish catch should be about $22 million annually by 1980.

Those who presented the Battelle report before the Commission were Richard J. Anderson, Dr. Richard J. Lund, David D. Moore, and Dr. B. D. Thomas.

Information gathered in the Battelle study, including specific recommendations for highway construction, will be considered for incorporation into a report being prepared for Congress by the Commission. The Commisison report is expected to provide a basis for coordinated efforts of Canada and the United States, as well as regional governments, in furthering the economic development of the area, according to Senator Warren Magnuson, acting Chairman of the Commission.

* MOLYBDATES INHIBIT CORROSION

The field of corrosion-inhibiting pigments has long been dominated by red lead, zinc chromate, and iron oxide. Each has found a place for reasons of cost, hiding power, and inhibitive capabilities. Possible new entries in this field are the molybdates. In addition to corrosion-inhibiting properties, they have the virtues of being nontoxic and white, which makes them advantageous in some applications. Thus, molybdates would be useful where white finishes are desired and they can be used safely with food and water.

The corrosion-inhibiting properties of the calcium and zinc molybdates were studied at Battelle for Climax Molybdenum Company, a division of American Metals Climax, Inc. Helmuth O. Schoen, Benson G. Brand, and Horatio H. Krause, Jr. report they found that molybdates generally equalled, and in some instances outperformed, red lead even when used in formulations for the latter.

The over-all costs of molybdates could conceivably be in the range of conventional inhibitors. Though costs per pound of the former are higher, lower specific gravity and better performance when used with extenders serve to reduce the final costs of molybdates.

Particularly pertinent observations on variables noted in the study are: (1) Calcium carbonate is a better extender for molybdates than is talc; (2) Corrosion is better inhibited by fine- than by coarse-particle-size molybdates; (3) Linseed oil is superior to alkyd resin as a vehicle for molybdates; (4) Increasing the molybdenum-to-zinc ratio from 1 to 1 to 1.4 to 1 lower the corrosion resistance of the molybdates.

The research at Battelle showed that in most instances, when the molybdates were used as a primer alone, calcium molybdate showed better over-all performance than either normal zinc molybdate or zinc polymolybdate, in that order. When used with topcoats, normal zinc molybdate and polymolybdate, in that order, were superior to calcium molybdate.

In general, the molybdates showed better corrosion inhibition when extended with calcium carbonate than when used without an extender. In one case, however, unextended zinc molybdate coatings so protected steel panels that scribe marks appeared shiny after a year's exposure near Columbus, Ohio.

BATTELLE STAFF MEMBERS recently named to technical posts include: *C. Malcolm Allen*—representative of American Society of Mechanical Engineers, 1961 Joint Conference Planning Committee, American Society of Lubrication Engineers—American Society of Mechanical Engineers Conference; *Charles L. Faust*—chairman, Publications Committee, The Electrochemical Society; *Robert I. Jaffee*—member, Task Group on the Presentation of Equilibrium Data, American Society for Testing Materials; *George W. James*—program chairman, National Association of Business Economists; *David C. Minton*—member, Advisory Council, The Patent, Trademark, and Copyright Foundation; *William T. Reid*—member (1960-64), Executive Committee, Solar Energy Applications Committee, ASME.

BATTELLE
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REVIEW

ABSTRACTS

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ADMINISTRATION AND PHILOSOPHY OF RESEARCH

New Men at the Machines. Discusses researchers who are doing their own analytical work instead of letting company central groups do it. Points out that there is still support for analytical specialists—but their role is being modified. *Chemical Week*, v. 87, no. 17, Oct. 22, 1960, p. 89 + 3 pages.

* **The Education and Training of the Professional Radio and Electronic Engineer.** Considers the size of the radio and electronics industry and the wide application of radio and electronic engineering in scientific research and in all branches of industry, commerce, and the defense services. *British Institution of Radio Engineers, Journal*, v. 20, Sept. 1960, p. 643-656.

* **The Investment Analyst's Evaluation of Industrial Research Capabilities.** The analyst who bears the heavy responsibility of investing and reinvesting other people's funds makes a detailed study of company operations and prospects for the future. Indispensable to his examination is the detailed study of the research and development work, both in its long- and short-term aspects, of the company under consideration. ***O. C. Roehl.*** *Research Management*, v. 3, no. 3, Autumn 1960, p. 127-145.

Creativity Can Be Stimulated. Discusses improved methods of selecting creative people for research laboratories and then stimulating their inventiveness to the full. ***Alfred E. Brown.*** *Chemical and Engineering News*, v. 38, no. 43, Oct. 24, 1960, p. 102 + 6 pages.

* **More D.S.I.R.—Industry Collaboration.** The research stations of the Department of Scientific and Industrial Research have been set up, to quote the D.S.I.R. Act, 1956, "for investigation and research relating to the advancement of trade and industry". It is therefore incumbent upon their directors not only to see that research work of high quality is done, but that it is of interest—either immediate or potential—to industry and that its results are applied by industry. Thus three stages are involved: the identification of problems; their solution; and ensuring that appropriate use is made of the solutions by industry. ***D. G. Sopwith.*** *Control*, v. 3, no. 28, Oct. 1960, p. 87.

* **What Do We Mean by Research and Development?** Basically, the research and development effort itself can be categorized in four parts: basic research, applied research, advanced development, and weapon system development. ***David Novick.*** *Air Force*, v. 43, Oct. 1960, p. 114 + 2 pages.

'People Are Our Biggest Assets'. Discusses the growth of a company and development of new products based on individuals and their talents. *Steel*, v. 147, Oct. 31, 1960, p. 40-41.

* **Government Support of Psychological Research Fiscal Year 1959.** The report presents information on the amount and sources of funds that have been made available from the federal government for the support of psychological research and reflects the relative emphasis being placed on specific areas of psychology. It also shows the distribution of funds on a geographical basis. The study is one of a series made by the National Science Foundation in partial fulfillment of its responsibilities for assessing the impact of government support programs upon research and education in the sciences. ***Marguerite L. Young and Henry S. Odbert.*** *American Psychologist*, v. 15, Oct. 1960, p. 661-664.

Nature of the Problem and Approaches to Solution. Part of the report of the Oval Room Work Group, 11th Annual Industrial Research Conference, Columbia University, Aug. 7-13, 1960, "Reconciling Professional and Personal Goals and Needs with Company Goals and Needs." Like all managers, the R/D administrator faces this basic roadblock in communication with his staff. Relationships are affected by who and what each person actually is, thinks he is, is trying to be; and thinks the other is, believes he is and is trying to be. *Research/Development*, v. 11, Oct. 1960, p. 7 + 6 pages.

* **Glass Research at the National Bureau of Standards.** The primary objective of this research is to increase knowledge of

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* Asterisks mark items that may be used in the Battelle Library only. None of the unbound materials listed are available for interlibrary loan.

the properties of glass so that it may be better utilized and find application in new products. *Laboratory Practice*, v. 9, Oct. 1960, p. 733-736.

* **How You Can Chart Future Goals of Your Company.** Discusses sponsoring an economic study to enable a company to make a sales and production forecast. ***Larston D. Farrar.*** *Inland and American Printer and Lithographer*, v. 146, no. 1, Oct. 1960, p. 59 + 4 pages.

* **Management's Most Exciting Challenge.** Learning to know research scientists and engineers as individuals is management's first task in effectively using this valuable talent. It is important that the particular characteristics of each key creative individual be recognized. The exciting challenge for management is to find a method for preventing the individual from riding roughshod over the group while, at the same time, preventing the group from engulfing the individual. ***Christopher E. Barthel, Jr.*** *Frontier*, v. 22, no. 4, Summer 1960, p. 8-12.

* **Engineers Challenged on Research.** MIT's Killian says engineers are losing stature because of research lag. ASCE convention told that research funds must be increased between 50 and 100%—and now. *Engineering News-Record*, v. 165, no. 16, Oct. 20, 1960, p. 21-22.

* **Speculative Research.** The discovery of polythene was the unforeseen result of a study of high-pressure reactions, and offered dynamic evidence that there is much to be said for basic research with no specific end-product in mind. This is the first of a series on the role of science in industry. ***Ritchie Calder.*** *Discovery*, v. 21, Oct. 1960, p. 420-425.

AERONAUTICAL AND ASTRONAUTICAL ENGINEERING

* **Reattachment of a Two-Dimensional, Incompressible Jet to an Adjacent Flat Plate.** The jet separates from the boundaries at the slot lips and re-attaches to the plate downstream, a phenomenon which is associated with the lowering of the pressure between the jet and the plate accompanying the entrainment of fluid there. The flow becomes independent of both the length of the plate and the Reynolds number when these parameters are sufficiently large. ***C. Bourque and B. G. Newman.*** *Aeronautical Quarterly*, v. 11, pt. 3, Aug. 1960, p. 201-232.

* **Limitations of the Sonic Area Rule.** An analysis of results for the sonic wave drag of swept-back, tapered wings suggested that the sonic area rule is applicable to thin wing and slender body combinations provided that the product of the wing span/length ratio and the cube root of the thickness/chord ratio is less than unity. The transonic drag-rise of the leading edge force is much greater than that predicted by theory. ***L. M. Sheppard.*** *Aeronautical Quarterly*, v. 11, pt. 3, Aug. 1960, p. 248-254.

* **The Stability of the Short-Period Motion of an Airframe Having Non-Linear Normal Force and Pitching Moment Curves.** An analysis of the stability of second-order non-linear systems by Poincaré's method of singular points in the phase plane is briefly presented and used to determine stability criteria for the short-period motion of an airframe having non-linear normal force and pitching moment curves. ***P. A. T. Christopher.*** *Aeronautical Quarterly*, v. 11, pt. 3, Aug. 1960, p. 255-268.

* **Further Comments on High-Lift Testing in Wind Tunnels With Particular Reference to Jet-Blowing Models.** Discusses some of the special problems of wind-tunnel testing which arise with high-lift jet-blowing models, supplementing earlier comments. Surveys recent developments on tunnel-wall interference, test rigs and methods of minimizing constraints from air-feeds to models, and on general test and model design techniques. ***S. F. J. Butler and J. Williams.*** *Aeronautical Quarterly*, v. 11, pt. 3, Aug. 1960, p. 285-308.

Surface Effects on Materials in Near Space. Since the space environment is not known completely and cannot be duplicated exactly in the laboratory, material tests must ultimately be conducted in space. Only from such studies can information be obtained for applying materials efficiently without fear of their degradation by unknown factors or without overdesign to compensate for our ignorance of their behavior in the actual space environment. ***Francis J. Clauss.*** *Aero/Space Engineering*, v. 19, Oct. 1960, p. 16 + 7 pages.

On Optimum Rocket Trajectories and the Calculus of Variations. Calculations are cited and discussed. ***R. M. Rosenberg.*** *Aero/Space Engineering*, v. 19, Oct. 1960, p. 20 + 2 pages.

Problems in Attitude Stabilization of Large Guided Missiles. Discusses rigid body control, wind input, and effects of elastic deformations and propellant sloshing upon stability and control. ***Ernst D. Geissler.*** *Aero/Space Engineering*, v. 19, Oct. 1960, p. 24 + 9 pages.

Design of Jet Transports With Rear-Mounted Engines. Discusses structural design, aerodynamics, systems engineering, safety, operations, loading and balance. Concludes that jet transports with rear-mounted engines are of great advantage. ***D. J. Lambert.*** *Aero/Space Engineering*, v. 19, Oct. 1960, p. 30 + 7 pages.

Parametric Weight Study of a Manned Space Entry Vehicle. The results of this study, in particular the radiation-cooled lunar vehicles, are based on assumed development of exotic materials, oxidation-protection coatings, and insulation requirements that are not developed to a point where hardware may be produced today. ***Onys A. Kelley, Jr.*** *Aero/Space Engineering*, v. 19, Oct. 1960, p. 40 + 10 pages.

Effects of Dissociation and Ionization at Hypersonic Velocities. The problems of dissociation and ionization of air components at high temperatures behind shock waves and on flat adiabatic walls parallel to the flow in a hypersonic velocity field are investigated. The thermochemic equilibrium is analyzed on a thermodynamic diagram of atmospheric air, utilizing simplified schemes of real flows. The dynamic relaxation problems are solved only in the velocity field where dissociation of O takes place. (*In Italian.*) Effetti della dissociazione e della ionizzazione alle velocità ipersoniche. ***Gianni Jarre.*** *Aerotechnica*, v. 40, no. 2, Apr. 1960, p. 99-111.

Particle Impacts on the Melt Layer of an Ablating Body. An equation is developed relating the increase in erosion rate, as a result of particle impacts, to flight and material parameters. The extent of the melt layer protection was found to be dependent on the particle size and melt layer thickness. One experimental check on the analysis was possible by inspection of the order of magnitude of the experimental liquid melt layer thickness on fired Micarta specimens. The computed melt layer thickness agreed with that observed on glass-reinforced Micarta 259-2 test specimens which were exposed in a rocket exhaust jet. ***E. W. Ungar.*** *ARS Journal*, v. 30, Sept. 1960, p. 799-805.

Determination of the Preliminary Orbits of Artificial Satellites From Observations With Time Approximately Known. The problem of determining the preliminary unperturbed orbit of a close Earth satellite is considered for the case when the instants of certain observations are known with rough approximation. The usual assumption, that the observations lie on one loop and cover not too large a section of the orbit, is made. Shows that the problem can be solved only if there are more than three observations. Equations are obtained for topocentric distances and for the quantities n_i° which are used to determine the time intervals between observations. A numerical example is given wherein the orbit is calculated from four observations with only two exact time values. ***Yu. V. Batrakov.*** *ARS Journal*, v. 30, Sept. 1960, p. 859-864. (From *Byulleten' Instituta Teoreticheskoi Astronomii*, v. 7, no. 7, (90), 1960, p. 570-580.)

Method for Improving Orbits of Artificial Satellites of the Earth Using Observations With Approximate Values of Time. A method is developed for improving the elements of orbits of artificial satellites in the case when the observation times are only approximately known. Corresponding equations of condition are set up, one of which is independent of the time errors. An analysis of the optimum conditions for the determination of these elements is made. Equations of condition are also obtained for the corrections to the absolute coordinates of the observation stations, and an analysis is made of these equations. ***D. K. Kulikov and Yu. V. Batrakov.*** *ARS Journal*, v. 30, Sept. 1960, p. 865-874. (From *Byulleten' Instituta Teoreticheskoi Astronomii*, v. 7, no. 7 (90), 1960, p. 554-569.)

Astronomical Constants and Their Importance in Lunar Trajectory Determination. Uncertainties result from insufficient accuracy in the constants utilized for the representation of such effects as Earth's bulge and equatorial radius, the lunar and solar masses and their position coordinates. An attempt is made to appraise the effects astronomical constants have on lunar vehicle impacts. This study shows that lunar impacts can only be predicted to fall into an area of about 78 miles in radius. ***C. Tross.*** *ARS Journal*, v. 30, Oct. 1960, p. 938-941.

Servo Control of a Variable Thrust Rocket. Completed tests of a variable thrust engine operated in a closed loop formed by feeding back a voltage proportional to chamber pressure to an electrohydraulically actuated injector are described. In effect, a "thrust" servomechanism was created which produces thrust proportional to a voltage input. The tests demonstrated closed loop thrust response to a voltage command equivalent to a second-order system flat to about six cps. ***J. J. Rodden and R. J. Pollak.*** *ARS Journal*, v. 30, Oct. 1960, p. 964-967.

The Exploration of Space. Describes present and future rocket vehicles. Surveys the present frontiers of space research and delineates major problems of the future. Gives properties of the moon and the planets and discusses plasma and magnetic fields in the solar system, the solar wind, low-energy cosmic ray events associated with solar flares, outer atmospheres of the earth and planets, the ages and origins of the meteorites, and rocket astronomy. ***Robert Jastrow, editor.*** 160 pp. 1960. The Macmillian Co., New York. (QC801 Sy68e)

Satellite Orbits About a Planet With Rotational Symmetry. A closed-form solution is obtained for the orbit of an Earth satellite which is influenced by the third harmonic in the potential in addition to the two dominant oblateness terms. The results are carried to the "second order" in the rates of the secular variations and in the periodic fluctuations. The secular equations are solved in closed form in two cases: when the inclination is close to 63.4° and when it is not. In the former case, the stability and period of the slow oscillation of the perigee are discussed. ***C. M. Petty and J. V. Breakwell.*** *Franklin Institute, Journal*, v. 270, no. 4, Oct. 1960, p. 259-282.

Frontiers of Science and Engineering. Proceedings of a symposium held in Los Angeles, Calif., Sept. 16-17, 1959. Discusses space environment, astromechanics, biomedicine, free radicals, solid state physics, cryogenics, operations research, transports, military aircraft, space vehicles, photography, instrumentation and inertial systems, electronics, and nuclear power. 132 pp. 1959. Institute of the Aeronautical Sciences, New York. (TL505 F92p)

Heat Transfer, Recovery Factor, and Pressure Distributions Around a Circular Cylinder Normal to a Supersonic Rarefield-Air Stream. Measurements are described for the Mach number range of 1.3-5.7, the Reynolds number range of 37-4,100. Study of the results yielded: a correlation equation for the stagnation-point Nusselt number as a function of the Reynolds number just after the normal part of the detached bow shock wave; and Fourier series expressions for the heat-transfer coefficient and pressure coefficient distributions in terms of the stagnation point values. ***O. K. Tewfik and W. H. Giedt.*** *Journal of the Aero/Space Sciences*, v. 27, Oct. 1960, p. 721-729.

Second-Order Theory for Unsteady Supersonic Flow Past Slender, Pointed Bodies of Revolution. The solution is obtained by approximating the nonlinear terms in the second-order potential equation by their first-order values and solving the resulting inhomogeneous partial differential equation, subject to more refined boundary conditions. The results indicate appreciable reductions in unsteady lift and damping moment coefficients when applied to slender cones. ***James D. Revell.*** *Journal of the Aero/Space Sciences*, v. 27, Oct. 1960, p. 730-740.

On the Response of the Laminar Boundary Layer to Small Fluctuations of the Free-Stream Velocity. The linearized treatment of small time-dependent disturbances of a laminar boundary layer, initiated by Lighthill, is extended in several ways. A practical method for obtaining the response to the laminar boundary layer to an impulsive change in velocity is presented. ***Nicholas Rott and Martin L. Rosenzweig.*** *Journal of the Aero/Space Sciences*, v. 27, Oct. 1960, p. 741 + 7 pages.

Dynamics and Thermodynamics of Re-Entry. Presents a summary of the approximate analytical solutions on velocity, altitude, range, deceleration, maximum deceleration, time rate and maximum time rate of average and local stagnation region heat transferred into vehicle, total heat transferred into vehicle, and time of flight for boost glide or orbital re-entry into planetary atmosphere for various kinds of re-entry trajectories. ***W. H. T. Loh.*** *Journal of the Aero/Space Sciences*, v. 27, Oct. 1960, p. 748-762.

Fluctuating Lift and Drag Acting on a Cylinder in a Flow at Supercritical Reynolds Numbers. Presents data on the root-mean-square values of the lift and drag coefficients, the extreme values of these coefficients, and their power spectra at various Reynolds numbers. ***Y. C. Fung.*** *Journal of the Aero/Space Sciences*, v. 27, Nov. 1960, p. 801-814.

Inviscid Flow With Nonequilibrium Molecular Dissociation for Pressure Distributions Encountered in Hypersonic Flight. One-dimensional inviscid nonequilibrium flows of a two-component model gas are studied for prescribed pressure variations and an average reaction rate based on recent data for O recombination. These flows are interpreted in relation to the flow along streamlines around blunt hypersonic bodies. Assuming equilibrium conditions in the subsonic region, it is estimated that the flow in the initial supersonic expansion region, which is approximately of Prandtl-Meyer character, will be chemically frozen with respect to the molecular dissociation of the primary components under the hypersonic, high-altitude flight conditions considered. The flight conditions consist of flight velocities between 15,000 and 25,000 ft./sec at altitudes between 154,000 and 246,000 ft. Futhermore, on bodies of small surface inclination beyond the nose, the flow will continue to be effectively frozen for at least 20 ft downstream of the nose. These conclusions may lead to the simplification of procedures for theoretical calculation and testing. The problem of distinguishing a dimensionless length-reaction rate parameter, which characterizes the extent of departures from equilibrium or from frozen behavior in the flow fields of interest here, is discussed. ***Martin H. Bloom and Martin H. Steiger.*** *Journal of the Aero/Space Sciences*, v. 27, Nov. 1960, p. 821 + 15 pages.

An Optical Boundary-Layer Probe. The applicability of the schlieren-photomultiplier technique to obtain quantitative density measurements in the laminar boundary layer induced by a traveling shock wave in a shock tube is investigated. Tests were conducted at a Mach number of 1.58 so that the data could be compared with the exact theoretical solution tabulated by Mirels. The data obtained are in good agreement with the theory if the distance of the light beam above the floor of the shock tube is adjusted to fit the theoretical curve; this would not be necessary if a larger shock tube were used. Values of the transition Reynolds number were also determined which are slightly less than those found by Martin using an interferometer. It is shown that this technique is sensitive enough to detect changes in density that are only 0.006 per cent of atmospheric density. ***John W. Daiber.*** *Journal of the Aero/Space Sciences*, v. 27, Nov. 1960, p. 836-840.

Closed-Loop Flip-Flop Control Systems. Basic concepts underlying the synthesis and analysis of closed-loop, flip-flop control systems of the electromechanical type are developed. Generalized design and analysis charts are presented to aid the engineer in gaining quickly an understanding of the relative importance of various elements in the system to the system's performance and stability. The importance of considering not only control-system dynamics, but also the damping provided by the airframe in developing practical flip-flop control systems is forcefully demonstrated to the engineer and scientist. Analog computer data, obtained as part of the present study, are used to substantiate analytic approaches and to advance the understanding of such systems. ***Milton Rogers and George Shapiro.*** *Journal of the Aero/Space Sciences*, v. 27, Nov. 1960, p. 841-853.

*** Proceeidngs of the National Specialists Meeting on Guidance of Aerospace Vehicles.** . . . held in Boston, Massachusetts, May 25-27, 1960. Discusses command and data link for an astronomical satellite, some considerations of guidance and control techniques for coplanar orbital rendevous, the long-time satellite rendezvous trajectory, guidance and control of point return vehicles, horizon sensors for vertical stabilization of satel-

lites and space vehicles, an accurate determination of attitude by optical means for applications in space vehicles, and other problems. 250 pp. 1960. Institute of the Aeronautical Sciences, New York. (TL795 N21p Over.)

Rarefied Gas Dynamics. Proceedings of the First International Symposium Held at Nice. Twenty-nine papers on the use of low-density wind tunnels in aerodynamic research, the ARDE low-density wind tunnel, techniques of measurement in rarefied gases, flow visualization, the application of supersonic beam sources to low density, high velocity experimentation, theory of rarefied gases, recent investigations of the Boltzmann equation, the Boltzmann-Maxwell equation as the fundamental equation of gas dynamics, experiment versus kinetic theory for rarified gases, and other problems. ***F. M. Devienne, editor.*** v. III. 442 pp. 1960. Pergamon Press, New York. (QC168 In8r)

Modern Techniques in Soaring Flight. Gives a scientific account of the art of gliding, describing the sources of atmospheric energy and how they are best used, the principles involved in the design of gliders to give optimum performance, and the instrumentation of gliders. ***F. G. Irving.*** *Research Applied in Industry*, v. 13, Oct. 1960, p. 411-416.

The Contraction of Satellite Orbits Under the Influence of Air Drag. I. With Spherically Symmetrical Atmosphere. The effect of air drag on satellite orbits of small eccentricity $e(<0{\cdot}2)$ is studied analytically by a perturbation method, on the assumption that the atmosphere is spherically symmetrical. Equations are derived which show (1) how perigee distance and orbital period vary with eccentricity as the orbit contracts, and (2) how each of these quantities varies with time. The equations of type (1) are nearly independent of the oblateness of the atmosphere. ***G. E. Cook, D. G. King-Hele, and Doreen M. C. Walker.*** *Royal Society, Proceedings*, v. 257, ser. A, Sept. 6, 1960, p. 224-249.

Axial-Force Reduction by Interference Between Jet and Neighboring Afterbody. Experimental results are presented for an exploratory investigation of the effectiveness of interference between jet and afterbody in reducing the axial force on an afterbody with a neighboring jet. Interference effects on normal force and center of pressure are also presented. The test Mach number was 2.94, the jet Mach number 2.71, and the Reynolds number 0.25 x 10^6 based on body diameter. The variables include static-pressure ratio of the jet (up to 9), nacelle position relative to the afterbody, angle of attack ($-5°$ to $10°$), and afterbody shape. The interference axial forces are large and favorable. For several configurations the total afterbody axial force is reduced to zero by the interference. ***William C. Pitts and Lyle E. Wiggins.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-332*, Sept. 1960, 95 pp. (TL570 Un3t Vis.)

Full-Scale Wind-Tunnel Tests of Blowing Boundary-Layer Control Applied to a Helicopter Rotor. Stall boundaries show a leading-edge blowing boundary-layer-control application delayed retreating blade stall in the advance ratio region of 0.34 to 0.46. Midchord blowing had no effect at advance ratios of 0.34 and 0.39. Limited tests also showed that the gains realized with the leading-edge boundary-layer-control application are obtained at reduced flow rates when a cyclic valve is used. ***John L. McCloud III, Leo P. Hall, and James A. Brady.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-335*, Sept. 1960, 34 pp. (TL570 Un3t Vis.)

Flight Performance of a Spin-Stabilized 20-Inch-Diameter Solid-Propellant Spherical Rocket Motor. The motor was fired at altitude after being boosted by a three-stage test vehicle. Analysis of the data indicates that a total impulse of 44,243 pounds per second with a propellant specific impulse of approximately 185 was achieved over a total action time of about 12 seconds. These results are shown to be in excellent agreement with data from ground static firing tests of these motors. The spherical rocket motor with an 11-pound payload attained a velocity of 15,620 feet per second ($M = 16.7$) with an incremental velocity increase for the spherical motor stage of 12,120 feet per second. ***Jack Levine, C. William Martz, Robert L. Swain, and Andrew G. Swanson.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-441*, Sept. 1960, 38 pp. (TL570 Un3t Vis.)

Effect of Reynolds Number on the Force and Pressure Distribution Characteristics of a Two-Dimensional Lifting Circular Cylinder. The lift coefficient showed a wide variation with Reynolds number for the 6% flap mounted on the bottom surface at the 50%-diameter station. The pressure distribution showed that the loss of lift with Reynolds number above the critical was the result of the separation point moving forward on the upper surface. The variation of drag coefficient with Reynolds number was in direct contrast to the lift coefficient with the minimum drag coefficient of 0.6 occurring at a Reynolds number of 360,000. At this point, the lift-drag ratios were a maximum at a value of 2.54. Tests of a flap with a chord of 0.0037 diameter gave a lift coefficient of 0.85 at a Reynolds number of 520,000 with the same lift-drag ratio as the larger flap, but the position of the flap for maximum lift was considerably farther forward than on the larger flap. ***Vernard E. Lockwood and Linwood W. McKinney.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-455*, Sept. 1960, 27 pp. (TL570 Un3t Room 290)

Some Dynamical Properties of the Natural and Artificial Satellites. Discusses some qualitative properties of the natural and artificial satellites in the solar system than can be understood in terms of the restricted three-body problem. Three problems are considered: the satellite system of Jupiter; the Trojan group of asteroids; and the behavior of artificial satellites in the Earth-Moon-Sun system. ***Su-Shu Huang.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-502*, Sept. 1960, 6 pp. (TL570 Un3t Room 290)

Studies of the Retardation Force Developed on an Aircraft Tire Rolling in Slush or Water. A series of unbraked taxi tests was conducted with a 32 x 8.8, type VII, 22-ply-rating aircraft tire to obtain data on tire retardation forces developed during rolling on both slush- and water-covered runway surfaces at forward velocities from 59 to 104 knots. Results indicated a parabolic increase of retardation force with increasing forward velocity in both slush and water. The retardation force was found to increase approximately linearly with increasing water depth. Calculations made to determine the effect of slush on the take-off distance of a jet transport are in agreement with the results obtained for an actual take-off in slush. ***Walter B. Horne, Upshur T. Joyner, and Trafford J. W. Leland.*** *U. S. National Aeornautics and Space Administration, Technical Note, NASA TN-D-552*, Sept. 1960, 29 pp. (TL570 Un3t Vis.)

Flight Measurement of Wall-Pressure Fluctuations and Bounadry-Layer Turbulence. Boundary-layer velocity profiles, wall-pressure fluctuations, turbulence intensity, and associated spectral distributions for pressure altitudes of 10,000, 20,000, and 30,000 feet and for subsonic Mach numbers in the range 0.3 to 0.8 were measured at forward-fuselage and wing stations on a fighter-type jet aircraft. The measurements are in general agreement with results obtained in flight and in wind tunnels. ***Harold R. Mull and Joseph S. Algranti.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-280*, Oct. 1960, 26 pp. (TL570 Un3t Vis.)

An Approximate Analytical Method for Studying Atmosphere Entry of Vehicles With Modulated Aerodynamic Forces. The differential equation developed in NASA TR R-11 for describing the approximate motion and heating during entry into planetary atmospheres for constant aerodynamic coefficients and vehicle shapes has been modified to include entries for which the aerodynamic coefficients and vehicle shape are varied. The generality of the application of the original equation to vehicles of arbitrary weight, size, and shape and to arbitrary atmospheres is retained. A closed-form solution is presented for the motion, heating, and the variation of drag loading parameter m/C_DA for the case of nonlifting entries with constant, maximum resultant deceleration. Results are presented to illustrate the effects of varying m/C_DA for nonlifting entries into the earth's atmosphere at escape velocity. ***Lionel L. Levy, Jr.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-319*, Oct. 1960, 31 pp. (TL570 Un3t Vis.)

An Experimental Investigation of Boundary-Layer Control for Drag Reduction of a Swept-Wing Section at Low Speed and High Reynolds Numbers. The model, installed between end plates, was a constant-chord wing panel with 30° of sweepback and a modified NACA 66-012 airfoil section in the streamwise direction. Boundary-layer control was applied to only

the upper surface of the model through 93 spanwise slots between the 0.0052- and 0.97-chord stations. Tests were made at angles of attack 0°, ±1.0°, ±1.5°, and −2.0° for Reynolds numbers from about 11 x 10^6 to 29 x 10^6 based on the streamwise chord. ***Donald E. Gault.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA-TN-D-320,* Oct. 1960, 18 pp. (TL570 Un3t Vis.)

Large-Scale Wind-Tunnel Tests of a Wingless Vertical Take-Off and Landing Aircraft—Preliminary Results. Tests were made of an aircraft design based on a flying duct principle. Propellers enclosed in the duct provide propulsion at forward speeds where the duct provides most of the lift. Exit vanes in the duct deflect the duct flow downward to provide lift at or near zero forward speed. Force and moment data are presented for tests made at zero sideslip for velocities between 0 and 70 knots and exit vane angles between 33° and 70°. ***David G. Koenig and James A. Brady.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-326,* Oct. 1960, 39 pp. (TL570 Un3t Vis.)

Large-Scale Wind-Tunnel Tests and Evaluation of the Low-Speed Performance of a 35° Sweptback Wing Jet Transport Model Equipped With a Blowing Boundary-Layer-Control Flap and Leading-Edge Slat. The typical four-engine jet transport model had a wing of aspect ratio 7. Three-component longitudinal force and moment data and boundary-layer-flow requirements are presented. The test results are analyzed in terms of estimated take-off and landing performance. The effect on performance of the source of boundary-layer-control airflow is considered. ***David H. Hickey and Kiyoshi Aoyagi.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-333,* Oct. 1960, 52 pp. (TL570 Un3t Vis.)

Effects of Sweep Angle on the Boundary-Layer Stability Characteristics of an Untapered Wing at Low Speeds. An investigation was conducted in the Ames 12-foot low-turbulence pressure tunnel to determine the boundary-layer stability and transition characteristics of an untapered variable-sweep wing (NACA 64_2A015 section) at subsonic speeds. Pressure-distribution and transition measurements were made at sweep angles from 0° to 50° and at angles of attack from −3° to 3°. Flow-visualization studies on the surface and total-pressure surveys in the boundary layer were also included for angles of attack from −12° to 0°. ***Frederick W. Boltz, George C. Kenyon, and Clyde Q. Allen.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-338,* Oct. 1960, 77 pp. (TL570 Un3t Vis.)

Experimental and Theoretical Study of a Rectangular Wing in a Vortical Wake at Low Speed. Experimental effects of a vortical wake on a trailing rectangular wing at subsonic speed were determined from measurements of the static pressures on the wing. Location of the vortex relative to the wing was systematically varied as well as the angle of attack of the wing. The vortex generator and wing were mounted on a reflection plane to avoid body-wing interference. A comparison is made between theory and experiment for vortex paths, induced lift, and spanwise induced load distribution. ***Willard G. Smith and Frank A. Lazzeroni.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-339,* Oct. 1960, 33 pp. (TL570 Un3t Vis.)

The Blunt Plate in Hypersonic Flow. The sonic-wedge characteristics method is used to investigate shock shapes and surface pressure distributions on several blunt two-dimensional shapes in a hypersonic stream. These shapes include the blunt slab alined with the stream and at an angle of attack and power profiles of the form y proportional to x^m where $0<m<1$. The effects of a free-stream conical-flow gradient on the pressure distribution on a blunt slab in hypersonic flow are investigated, and procedures for reducing pressure data obtained in conical flows with small gradients are presented. ***Donald L. Baradell and Mitchel H. Bertram.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-408,* Oct. 1960, 49 pp. (TL570 Un3t Vis.)

A Summary of Operating Conditions Experienced by Three Military Helicopters and a Mountain-Based Commercial Helicopter. Flight conditions comprising the flight profiles of three military helicopters engaged in simulated and

actual military missions, and of a commercial helicopter engaged in mountainous, high-altitude missions are presented. Tables and graphs present the results that were obtained through the use of NASA helicopter VGHN recorders. ***Andrew B. Connor.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-432,* Oct. 1960, 21 pp. (TL570 Un3t Vis.)

Transonic and Supersonic Wind-Tunnel Tests of Wing-Body Combinations Designed for High Efficiency at a Mach Number of 1.41. Wind-tunnel force tests of a number of wing-body combinations designed for high lift-drag ratios at a Mach number of 1.41 are reported. Results are shown for four differently indented bodies in combination with two differently warped wings. For comparison purposes, data for a plane wing and two non-indented bodies are also shown. All wings had the same highly swept discontinuously tapered planform with NACA 65A-series airfoil sections 4 per cent thick at the root, tapering to 3 per cent thick at the tip. The supersonic test Mach numbers were 1.41 and 2.01. The transonic Mach number range was from 0.6 to 1.2. ***Frederick C. Grant and John R. Sevier, Jr.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-435,* Oct. 1960, 82 pp. (TL570 Un3t Vis.)

Bonded and Sealed External Insulations for Liquid-Hydrogen-Fueled Rocket Tanks During Atmospheric Flight. Several currently available nonmetallic insulation materials that may be bonded onto liquid-hydrogen tanks and sealed against air penetration into the insulation were investigated for application to rockets and spacecraft. Experimental data were obtained on the thermal conductivities of various materials in the cryogenic temperature range, as well as on the structural integrity and ablation characteristics of these materials at high temperatures occasioned by aerodynamic heating during atmospheric escape. Of the materials tested, commercial corkboard has the best over-all properties for the specific requirements imposed during atmospheric flight of a high-acceleration rocket vehicle. ***V. H. Gray, T. F. Gelder, R. P. Cochran, and J. H. Goodykoontz.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-476,* Oct. 1960, 51 pp. (TL570 Un3t Vis.)

Supersonic Aerodynamic Characteristics of a Low-Drag Aircraft Configuration Having an Arrow Wing of Aspect Ratio 1.86 and a Body of Fineness Ratio 20. A low-drag aircraft configuration was flight tested between Mach numbers of 1.2 and 1.9. From the results of this investigation, it is observed that very slender body shapes can provide increased volumetric capacity with little or no increase in zero-lift drag and that body fineness ratios of the order 20 should be considered in the design of long-range supersonic aircraft. Maximum lift-drag ratios of 7.0 and 6.6 at Mach numbers of 1.25 and 1.81, respectively, were obtained. Values of certain rolling derivatives were determined by the least-squares method. ***Warren Gillespie, Jr.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-509,* Oct. 1960, 59 pp. (TL570 Un3t Vis.)

Shock-Wave Laminar-Boundary-Layer Interaction on a Convex Wall. The results of some experimental and theoretical studies of the interaction of oblique shock waves with laminar boundary layers on a curved surface are presented. The theoretical work extends a flat-plate model, previously derived, to include the effects of surface curvature on the pressure levels characteristic of separation and on the length of the separated region. Pressure measurements on a curved surface bear out the prediction of the pressure in the constant-pressure separated region. The measurements of length of separated region are not conclusive because of insufficient data for long separated regions. ***Isaac Greber.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-512,* Oct. 1960, 28 pp. (TL570 Un3t Vis.)

Static Longitudinal Stability and Control Characteristics at a Mach Number of 1.99 of a Lenticular-Shaped Reentry Vehicle. A model composed of a lenticular-shaped body with two-fin configuration was tested at angles of attack from 0° to 90°. The body alone was unstable from an angle of attack of 0° to about 35° where it became stable and remained so to 90°. The model with fins was stable throughout the entire angle-of-attack range. Deflecting the fins appeared to be an effective means of pitch control. ***Charlie M. Jackson, Jr. and Roy V.***

Harris, Jr. *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-514,* Oct. 1960, 16 pp. (TL570 Un3t Vis.)

Use of Subsonic Kernel Function in an Influence-Coefficient Method of Aeroelastic Analysis and Some Comparisons With Experiment. This method of analysis is developed for calculating the response of a flexible wing to a sinusoidal force in an airstream and for treating such aeroelastic instabilities as flutter and divergence. Aerodynamic influence coefficents are derived by use of the kernel-function procedure, and application is made to a uniform cantilever wing-tip tank configuration for which responses to a sinusoidal force and flutter speeds were measured over a wide range of subsonic Mach numbers. ***John L. Sewall, Robert W. Herr, and Charles E. Watkins.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-515,* Oct. 1960, 86 pp. (TL570 Un3t Vis.)

An Investigation of Landing-Contact Conditions for a Large Turbojet Transport During Routine Daylight Operations. Statistics are presented of the landing-contact conditions of vertical velocity, airspeed, rolling velocity, bank angle, and distance from the runway threshold for 103 landings of a large turbojet transport during routine daytime operations at the Los Angeles International Airport. ***Joseph W. Stickle and Norman S. Silsby.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-527,* Oct. 1960, 20 pp. (TL570 Un3t Vis.)

Basic Pressure Measurements at a Mach Number of 1.43 on a Thin 45° Sweptback Highly Tapered Wing With Systematic Spanwise Twist Variations. Pressure data are presented on an untwisted wing, and wings with linear, quadratic, and cubic twist variations. The tests were made at a Mach number of 1.43 and covered an angle-of-attack range from −4° to 20°. The average Reynolds number based on the wing mean aerodynamic chord was 2.9 x 10^6 during tests at 1.0 atmosphere and 1.5 x 10^6 during tests at 0.5 atmosphere. ***John P. Mugler, Jr. and Elizabeth R. Woodall.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-528,* Oct. 1960, 73 pp. (TL570 Un3t Vis.)

Experimental Investigation of the Natural Frequencies of Liquids in Toroidal Tanks. Several toroidal tank configurations applicable to missile and space-vehicle liquid storage systems were oscillated to study the natural frequencies of the antisymmetric modes of contained liquids over a range of liquid depths and tank sizes. Natural frequencies were obtained for tank oscillations parallel to the free surface for both horizontal and vertical tank orientations. The data are presented in terms of dimensionless parameters suggested by the physics of the problem and by solutions for liquids in tanks having similar boundaries at the liquid surface. The experimental results indicate that these parameters are applicable to the prediction of the natural frequencies of liquids in toroids of general geometry and size. ***John Locke McCarty, H. Wayne Leonard, and William C. Walton, Jr.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-531,* Oct. 1960, 26 pp. (TL570 Un3t Vis.)

Flight Evaluation of Several Spring Force Gradients and a Bobweight in the Cyclic-Power-Control System of a Light Helicopter. Results are presented of a flight evaluation of a light helicopter having a power-control system modified to include several feel-spring rates and a bobweight and viscous damper in the longitudinal control system. Evaluation was purely qualitative, made up of pilot opinion. Pilots consisted of eight research pilots and four research engineers from NASA familiar with stability and control problems. A feel spring of ½ lb/in. and a bobweight of 14 lb/g provided desirable control feel forces. ***Donald L. Mallick and John P. Reeder.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-537,* Oct. 1960, 9 pp. (TL570 Un3t Vis.)

Effects of Fineness Ratio and Reynolds Number on the Low-Speed Crosswind Drag Characteristics of Circular and Modified-Square Cylinders. A wind-tunnel investigation was made at several fineness ratios between 2 and 14 for a range of Reynolds numbers from approximately 300,000 to 1,650,000 which corresponded to Mach numbers from 0.057 to 0.377. Effects of hemispherical ends on the drag characteristics of some of the circular cylinders were also obtained. These data may be

useful in making preliminary calculations on rocket configurations and airplanes having long nose sections at high angles of attack. ***Linwood W. McKinney.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-540,* Oct. 1960, 15 pp. (TL570 Un3t Vis.)

Landing-Impact Characteristics of Load-Alleviating Struts on a Model of a Winged Space Vehicle. Brief landing-impact tests were made of a 1/9-scale model of a delta-winged space vehicle landing on hard surface and on water. The use of yielding-metal shock absorbers and various landing-gear arrangements was investigated. Results show maximum hard-surface landing accelerations of approximately 5½g over a range of landing parameters. Landings in smooth water resulted in a maximum acceleration of approximately 4g with provision of adequate planning area at the nose skid. ***Ulysse J. Blanchard.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN-D-541,* Oct. 1960, 19 pp. (TL570 Un3t Vis.)

AGRICULTURE

Development of a Mechanical Tomato Harvester. ***B. A. Stout and S. K. Ries.*** *Agricultural Engineering,* v. 41, Oct. 1960, p. 682-685.

Whey Utilization. II. Oxygen Requirements of *Saccharomyces fragilis* Growing in Whey Medium. III. Oxygen Absorption Rates and the Growth of *Saccharomyces fragilis* in Several Propagators. II. ***Aaron E. Wasserman.*** III. ***Aaron E. Wasserman and James W. Hampson.*** *Applied Microbiology,* v. 8, no. 5, Sept. 1960, p. 291-297.

* **Effects of Artificially Produced Atmospheric Electrical Fields Upon the Activity of Some Adult Diptera.** Some effects of experimental electrical fields on the amount of movement of *Drosophila* and *Calliphora* are discussed. Activity in *Drosophila* was temporarily reduced by sudden exposure to a potential gradient as low as 10 to 62.5 v/cm and of constant polarity. A more transient reduction of activity was observed in *Calliphora;* however, a much stronger field was necessary to produce the effect. ***D. K. Edwards.*** *Canadian Journal of Zoology,* v. 38, no. 5, Oct. 1960, p. 899-912.

* **Gypsy Moth (*Porthetria dispar*) Detection With the Natural Female Sex Lure.** Traps baited with the sex lure secreted by the nonflying gypsy moth female attract the flying male of the species. With these traps, large areas may be scouted for the presence of the moth. Problems in connection with the trapping of the male moths are discussed. ***R. F. Holbrook, Morton Beroza, and Emory D. Burgess.*** *Journal of Economic Entomology,* v. 53, no. 5, Oct. 1960, p. 751-756.

* **Feed Additives for Control of House Fly Larvae in Livestock Feces.** There was no reduction in the numbers of house flies completing development from egg to adult in feces from a steer fed up to 100 gm./day of Polybor 3. ***T. L. Harvey and J. R. Brethour.*** *Journal of Economic Entomology,* v. 53, no. 5, Oct. 1960, p. 774-776.

* **Tests With Compounds Affecting House Fly Metabolism.** Two-hundred compounds were tested for ability to sterilize the normal development of house flies. Only 10 affected development when combined with the adult food. Amethopterin, the most active compound, caused sterility in the females but not in the males, in a single feeding when given in the initial meal, and reduced subsequent oviposition when given in a later meal. ***G. C. LaBreeque, P. H. Adcock, and Carroll N. Smith.*** *Journal of Economic Entomology,* v. 53, no. 5, Oct. 1960, p. 802-805.

BIOCHEMISTRY AND BIOPHYSICS

* **A New Class of Pharmacologically Active Substances Possessing a Well-Pronounced Influence on the Central Nervous Systems.** Describes the basic parameters of the pharmacological activity of derivatives of 2-amino-2-phenyl indandione-1.3 of three different types. (*In Russian.*) Novyĭ klass

farmakologicheski aktivnykh veshchestv s vyrazhennym vlianiem na tsentral'nuiu nervnuiu sistemu. ***M. L. Belen'kiĭ, S. K. Germane, A. K. Aren, and G. Ia. Vanag.*** *Akademiia Nauk SSSR, Doklady*, v. 134, no. 1, Sept. 1960, p. 217-220.

* **An Attempt to Induce Hereditary Variations in *Bombyx mori* L. by Means of Interstrain Injections of Desoxyribonucleic Acid.** (*In Russian.*) Opyt poluchenііa nasledstvennykh izmeneniĭ y tutovogo shelkopriada (Bombyx mori L.) posredstvom mezhlineĭnykh in'ektsiĭ dezoksiribonukleinovoĭ kisloty. ***T. A. Bedniakova, G. I. Gintsburg, I. B. Zbarskiĭ, and G. P. Ramenskaia.*** *Akademiia Nauk SSSR, Doklady*, v. 134, no. 2, Sept. 1960, p. 449-452.

* **The Effect of Temperature on the State of Macromolecules of High Polymer Ribonucleic Acid From Animal Tissues.** (*In Russian.*) Deĭstvie temperatury na sostoianie makromolekul vysokopolimernoĭ ribonukleinovoĭ kisloty iz zhivotnykh tkaneĭ. ***A. S. Spirin and L. S. Mil'man.*** *Akademiia Nauk SSSR, Doklady*, v. 134, no. 3, Sept. 1960, p. 717-720.

* **Intermittent Radiation and the Life Span of Mice.** ***James T. Duhig and Shields Warren.*** *AMA Archives of Pathology*, v. 70, Oct. 1960, p. 486-496.

* **Antiviral Extracts From *Propionibacteria*.** Fermentation extracts of *P. freudenreichii* contained antiviral activity against Columbia SK virus in mice. Reductions of mortality from rates of the order of 75% in the controls to 55% in treated animals were observed. The active substance in the extracts was called propionin. ***Windsor Cutting, et al.*** *Antibiotics & Chemotherapy*, v. 10, Oct. 1960, p. 623-625.

* **Ciin and Its Combinations With Antibiotics in Acute Radiation Disease of Mice.** White mice received a single dose of 300 γ of ciin 24 hr before their treatment with X-rays at a dose lethal for 85-100% of animals. Under these conditions the survival index of mice, treated with ciin, was equal to 0.64, instead of 0.19 recorded among the controls. In experiments, where preliminary administration of ciin beginning from the 4th to 5th day was accompanied by treatment with antibiotics (6000 un. bicillin twice a week and 1000 un. of dihydrostreptomycin daily), the survival index was 0.92. (*In Russian.*) Tsiin i ego sochetanie s antibiotikami pri ostroĭ luchevoĭ bolezni mysheĭ. ***Z. V. Ermol'eva, G. E. Waisberg, N. I. Givental', and T. N. Likina.*** *Antibiotiki*, v. 5, no. 4, July-Aug. 1960, p. 37-41.

International Review of Cytology. Discusses the influence of cultural conditions on bacterial cytology, organizational patterns within chromosomes, enzymic processes in cells, the adhesion of cells, physiological and pathological changes in mitochondrial morphology, the study of drug effects at the cytological level, histochemistry of lipids in oogenesis, cytoembryology of echinoderms and amphibia, and the cytochemistry of nonenzyme proteins. ***G. H. Bourne and J. F. Danielli, editors.*** v. IX. 424 pp. 1960. Academic Press, New York. (QH581 In8 Vis.)

* **The Specificity of the Nonspecific.** Although plant hemagglutinins were long thought to be nonspecific, some have been found to have a blood-group specificity which is quite sharp. Some of these agglutinins have found important practical applications in blood group techniques. ***William C. Boyd.*** *Journal of Immunology*, v. 85, no. 3, Sept. 1960, p. 221-229.

Specific Inhibitors of the Adrenal Cortex. All the compounds which are potent adrenal inhibitors appear to possess two six-membered rings linked together by one or two C chains. In the case of amphenone and of DDD, phenyl groups are attached to the same C atom, while in the case of SU-4885, they are attached to adjacent C atoms. The effect of substitution on function is not clear. The presence of substitutions on the phenyl rings is not necessary for activity but substitution appears to enhance the activity in some cases. ***J. H. U. Brown.*** *Nature*, v. 187, Sept. 17, 1960, p. 985-989.

Fate of Transforming Deoxyribonucleate Following Fixation by Transformable Bacteria. I.-II. Transforming deoxyribonucleate becomes integrated into the genome of the recipient bacteria during the first few minutes following the fixation of the deoxyribonucleate. Transforming deoxyribonucleate re-isolated immediately after its fixation has suffered a loss of function, and this function is rapidly recovered on incubation of the transformed bacteria. I. ***Maurice S. Fox and Rollin D. Hotchkiss.*** II. ***Maurice S. Fox.*** *Nature*, v. 187, Sept. 17, 1960, p. 1002-1006.

Effect of Glycerine on the X-Ray Sensitivity of *Serratia marcescens*. The observations on *Serratia marcescens* indicate that protection of aerobic organisms is brought about by some mechanism other than O scavenging or competition with O for radiation-induced radicals, and that organisms which are anaerobic when irradiated can also be substantially protected by the presence of glycerine. Glycerine also protected cells from the effect of X-rays when the bacterial suspension was gassed with N or with 10% nitric oxide in nitrogen anoxia. ***D. L. Dewey.*** *Nature*, v. 187, Sept. 17, 1960, p. 1008-1010.

Severe Distortion by 5-Bromouracil of the Sequence Characteristics of a Bacterial Deoxyribonucleic Acid. ***Herman S. Shapiro and Erwin Chargaff.*** *Nature*, v. 188, Oct. 1, 1960, p. 62-63.

* **The Physiological Basis of Thirst.** Suggests that central areas of the nervous system, which are permeated by trypan blue, form a system which samples the effective osmotic pressure and perhaps the volume of the blood, and integrates this information into the adjustive actions of renal regulation and intake behavior. ***John L. Falk.*** *Nutrition Reviews*, v. 18, Oct. 1960, p. 289-291.

Virus Interference and Interferon. It is well known that virus infections are resistant to drugs and antibiotics. Reasons for this are discussed, and the discovery of interferon, which acts as a viral antibiotic is described. Interferon, a product of the virus interference phenomenon, is a protein which can block the multiplication of a number of animal viruses. ***D. C. Burke.*** *Research Applied Industry*, v. 13, Oct. 1960, p. 398-403.

CERAMICS AND CONCRETE

Refractory Compositions Based on Silicon-Boron-Oxygen Reactions. The nature and properties of a refractory material formed by reacting Si and B in air are described. The resulting material consists of free Si and a new compound, SiB_4, dispersed in a borosilicate matrix. This refractory is stable in air to temperatures exceeding 1550 C, is thermal-shock resistant, and has a low density. ***H. F. Rizzo, B. C. Weber, and M. A. Schwartz.*** *American Ceramic Society, Journal*, v. 43, Oct. 1960, p. 497-504.

Volatility of Lead Silicate and Lead Borate Binary Melts. At comparable temperatures, the volatility of the binary lead silicate melt is higher than that of the lead borate of corresponding PbO to B ratio. The volatilization of PbO is diffusion controlled. The approximate vapor pressure of PbO at 900 C is 0.2 mm Hg. ***Chikara Hirayama.*** *American Ceramic Society, Journal*, v. 43, Oct. 1960, p. 505-509.

Sublimation of Cr_2O_3 at High Temperatures. Extensive sublimation did not yield any new phases on the basis of X-ray powder studies, and condensates of Cr_2O_3 were always obtained. Flash vaporization and flow experiments in CO or O_2 atmospheres and in vacuum indicated no appreciable differences in rates of sublimation. ***Ke-Chin Wang, Lloyd H. Dreger, V. V. Dadape, and John L. Margrave.*** *American Ceramic Society, Journal*, v. 43, Oct. 1960, p. 509-510.

Hot Pressing of Fused Silica. The hot pressing of powdered fused silica at temperatures below the melting and devitrification regions is described. The fabrication of high-density shapes is possible by this process. ***Thomas Vasilos.*** *American Ceramic Society, Journal*, v. 43, Oct. 1960, p. 517-519.

Oxidation Studies of Urania-Thoria Solid Solutions. The changes occurring in O content during solid solution formation and densification were determined for a 70.4 mole % UO_2-29.6 mole % ThO_2 composition formed by sintering U_3O_8-ThO_2 in air. The first evidence of solid solution occurred at 1000 C and solution was complete above 1250 C. ***E. D. Lynch, J. H. Handwerk, and C. L. Hoenig.*** *American Ceramic Society, Journal*, v. 43, Oct. 1960, p. 520-524.

Temperature Dependence of Plastic Yield Stress of Single Crystals of Magnesium Oxide. Annealing followed by a rapid quenching produces a marked softening, and at the same time causes a homogenization of the starting material. Samples have been found to display inflections in strength versus temperature, corresponding to a minimum near 500 C followed by a maximum near 700 C. ***J. E. May and M. L. Kronberg.*** *American Ceramic Society, Journal,* v. 43, Oct. 1960, p. 525-530.

* **Monolithic Cast-In-Place Concrete Pipe.** The development and use of monolithic cast-in-place concrete pipe is discussed, including the merits of this type of water-carrying conduit. The various factors that should be considered in evaluating the practicability of the use of this type of conduit are outlined. General summary is made of advantages and limitations of different construction methods. ***L. H. Kristof.*** *American Concrete Institute, Journal,* v. 32; *ACI Proceedings,* v. 57, no. 5, Nov. 1960, p. 533-547.

* **Reactivity of Ultrafine Powders Produced From Siliceous Rocks.** Siliceous materials such as quartz and basic or devitrified volcanic rocks, which are not likely sources of active pozzolan, become highly reactive when ground to ultrafine powders. If grinding is sufficiently prolonged, an upper limit of activity is attained, beyond which continued increase in surface area does not produce any further general increase in pozzolanic reactivity. With widely differing types of siliceous material, the upper limit of pozzolanic reactivity attained at very high surface areas tends to be the same in all cases, regardless of whether the mineral powders would be classed as pozzolanic, weakly pozzolanic, or nonpozzolanic when ground to the usual fineness specified for pozzolans. These observations can be explained by the presence of a disturbed layer of highly reactive material which is formed on the surface of siliceous mineral particles as a result of prolonged grinding. ***K. M. Alexander.*** *American Concrete Institute, Journal,* v. 32; *ACI Proceedings,* v. 57, no. 5, Nov. 1960, p. 557-569.

Refractory Materials. Surveys 122 refractory materials including graphite, 12 refractory metals, 18 carbides, 13 oxides, 12 nitrides, 17 silicides, 19 borides, 22 sulfides and 8 intermetallic compounds. Discusses availability, extraction, processing, consolidation, fabrication, stability, mechanical behavior at low and high temperatures, physical properties and thermal stresses. ***R. I. Jaffee and D. J. Maykuth.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 44, Feb. 26, 1960, 32 pp. (TN799 B32.2d Contin.)

Data Book on Uranium Dioxide. Physical properties, UO_2 preparation methods, properties of UO_2 prepared by different methods, comparison between surface area and density of UO_2 powders and their parent compounds, physical methods of preparing UO_2 powders and their properties, oxides of uranium, effect of calcination temperature, effect of reduction conditions on the stability of UO_2 powders, and other data are given. ***G. M. Butler, Jr. and Henry H. Hausner, compilers.*** 56 pp. 1960. Gladding, McBean and Co., Los Angeles. (TN693.U7 G45d)

Study of Dehydration of Montmorillonite and Vermiculite by Infrared Spectroscopy. Dehydration processes for homoionic montmorillonites and vermiculites were investigated by studying variations of *d001* spacings (by X-ray diffraction), intensity of angular vibration band of water (at 6.1μ) and intensity and composition of OH vibration band (2.7 to 3.5μ), in relation to dehydration temperature. Experimental results show that water molecules remain up to a final stage of dehydration, and even after the collapse of the interlayer space. Lattice dehydroxylation starts before dehydration is achieved. ***J. J. Fripiat, J. Chaussidon, and R. Touillaux.*** *Journal of Physical Chemistry,* v. 64, Sept. 1960, p. 1234-1241.

* **Electrical Resistivities and Lattice Constants of Uranium Dioxide.** Measurements were made between −100 and +750 C. The more the sample contains excess 0, the smaller are the electrical resistivities. The higher the temperature, the larger the irreversibility in the resistivity-temperature curve. ***Ryukiti R. Hasiguti, Etsuyuki Matsuura, Shiori Ishino, and Kazuko Minami.*** *National Research Institute for Metals, Transactions,* v. 2, no. 1, 1960, p. 1-5.

* **Properties of Cerium Dioxide and Its Solid Solutions With Calcium and Strontium Oxides.** By firing at 1500 C, it is possible to obtain well-sintered compositions with 0.1%

porosity and up to 2000 kg/cm² compressive strength. In order to obtain well-sintered products from pure CeO_2, the material must be finely ground. Specimens of CeO_2 and its solid solution with Sr oxide exhibit a high chemical resistance in contact with other refractory oxides up to 1600-1700 C. (*In Russian.*) Svoĭstva dvuokisi tseriia i ee tverdykh rastvorov s okislami kal'tsiia i strontsiia. ***L. S. Zueva, N. A. Godina, and E. K. Keler.*** *Ogneupory,* v. 25, no. 8, 1960, p. 368-371.

Oxide Ceramics. Physical Chemistry and Technology. Discusses general fundamentals of sintered oxide ceramics, including alumina, spinel, magnesia, beryllia, zirconia, zirconium silicate, thoria, ceria, and compound oxide-metal and oxide-carbide ceramics. ***Eugene Ryshkewitch.*** 472 pp. 1960. Academic Press, New York. (TP807 R98o)

Electron-Microscopic Observations on Radiation Damage in Graphite. Transmission electron microscopy was applied to the study of lattice defects introduced by neutron irradiation. The dark-field technique proved to be especially useful for this purpose. The technique of preparation is described and a tentative interpretation of the observations is given. ***W. Bollman.*** *Philosophical Magazine,* v. 5, ser. 8, June 1960, p. 621-624.

Micro-Cracks and Their Relation to Flow and Fracture in Single Crystals of Magnesium Oxide. Evidence on mechanisms of fracture in MgO single crystals subjected to tensile loading is given. As-cleaved crystals contain micro-cracks typically 10^{-4} in. long, and slip originating from near these cracks occurs during deformation. At a later stage, the cracks grow gradually until they increase to a critical size when catastrophic propagation occurs. ***F. J. P. Clarke and R. A. J. Sambell.*** *Philosophical Magazine,* v. 5, ser. 8, July 1960, p. 697-707.

Conventional and Invert Glasses Containing Titania. I. The behavior of several physical properties as a function of the structure parameter Y is reviewed for conventional and invert glasses. Glasses containing titania do not show the general behavior as far as the dielectric properties are concerned but they do exhibit it in respect of the viscosity and the coefficient of expansion. The phenomena observed may be attributed to a reinforcement of the structure by the Ti^{4+} ions which is brought about in the conventional composition region, and the formation of sub-microscopic regions of crystallites in the invert region. ***H. J. L. Trap and J. M. Stevels.*** *Physics and Chemistry of Glasses,* v. 1, no. 4, Aug. 1960, p. 107-118.

A New Approach to the Thermal Change in the Refractive Index of Glasses. The thermal change in the refractive index is considered as resulting from two counteracting factors: the lattice expansion and the electron polarizability. This approach accounts for several aspects of glass behavior. ***L. Prod'homme.*** *Physics and Chemistry of Glasses,* v. 1, no. 4, Aug. 1960, p. 119-122.

The Density, Refractive Index and Specific Refraction of Vitreous Boron Oxide and of Sodium Borate Glasses as Functions of Composition, Method of Preparation, and Rate of Cooling. ***F. C. Eversteijn, J. M. Stevels, and H. I. Waterman.*** *Physics and Chemistry of Glasses,* v. 1, no. 4, Aug. 1960, p. 123-133.

The Diamond Pyramid Hardness of Sodium Borate Glasses as a Function of Their Composition and Heat Treatment. The D.P.H. (diamond pyramid hardness) was determined on seven quenched or annealed Na_2O-B_2O_3 glasses having compositions with Na_2O contents ranging from 5-31% by weight. Quenched glasses were found to exhibit a maximum hardness at a composition containing about 25 wt% of Na_2O. The D.P.H. values of annealed glasses are higher than those of corresponding quenched glasses. The former do not exhibit a pronounced maximum, but there is a range of compositions going from 17-28% of Na_2O by weight within which the D.P.H. is greatest (500 kg/mm²). ***F. C. Eversteijn, J. M. Stevels, and H. I. Waterman.*** *Physics and Chemistry of Glasses,* v. 1, no. 4, Aug. 1960, p. 134-136.

A Metallographic Technique for Ferrites. A technique is described for the rapid preparation of ferrite specimens for metallographic examination by means of polytetrafluorethylene polishing laps impregnated with diamond. ***J. E. Hughes and S. Ratcliffe.*** *Powder Metallurgy,* no. 5, 1960, p. 81-84.

Detection of Strength-Impairing Surface Flaws in Glass. Experiments show that the cracks produced by Na vapor treatment on the surface of glass are fractures due to a superficial tensile stress developed on cooling in a surface layer of higher thermal expansion. Tensile surface stresses and corresponding systems of cracks can also be developed, in soda-lime glass, by the treatment with a molten Li salt. The points of origin of the crack systems can be clearly recognized; they must be the sites of Griffith cracks. ***F. M. Ernsberger.*** *Royal Society, Proceedings,* v. 257, ser. A. Sept. 6, 1960, p. 213-223 + 4 plates.

Measurement of Surface Area of Uranium Dioxide Powder and Sintered Pellets. The surface areas of sintered UO_2 pellets (individual pellets ranging from 50 to 2000 cm^2) were measured with a precision of 1.3% and a reproducibility of about 4% with a BET adsorption apparatus, using krypton as the adsorbate. Powder samples (10 to 50 mg) of UO_2, anatase, ZrO_2, and CeO_2 were measured with a precision of 0.5% and a reproducibility of about 3%. An excellent correlation was found between the surface area and the average particle diameter, as measured with a Fisher Sub-Sieve Sizer. An equation, relating the surface area (S) and the average particle diameter (D) [$S = 1.67/D$, as compared to $S = 0.547/D$ (if the particles were spherical)] shows the powder has a shape factor of about 3. ***T. Smith.*** *U. S. Atomic Energy Commission, NAA-SR-5319,* Oct. 1960, 42 pp. (UF767 Un3.1na Contin.)

Effect of Isomorphic Substitutions on Properties of Fluormica Ceramics. Isomorphically substituted fluormicas were prepared by solid-state reaction, then hot pressed to give polycrystalline ceramics. One hundred forty-four such products were made, covering a wide range of substitutions and hot pressing conditions. Properties of the products were determined, such as density, machinability, color, modulus of rupture, apparent porosity, wet and dry dielectric constant and power factor, resistivity versus temperature, dielectric strength, thermal expansion, thermal stability, and hardness. Specialized processes or studies included phosphate additions before hot pressing, variation of F^-, oxalic acid additions, direct hot pressing of raw materials, mixtures of micas with each other or with other materials, and fluormica-powdered nickel cermets. ***H. R. Shell.*** *U. S. Bureau of Mines Report of Investigations* 5667, 1960, 40 pp. (TN21 Un3r Vis.)

CHEMICAL ENGINEERING

Performance Characteristics of an Electromagnetic Pump. ***David H. Thompson and Ray W. Fisher.*** *U. S. Atomic Energy Commission, IS-188,* Aug. 1960, 49 pp. (UF767 Un3.1isu Contin.)

* **Water Desalting.** Résumé of some informative and timely papers presented at the 80th Annual Conference of the AWWA at Bal Harbour, Florida. *Water & Sewage Works,* v. 107, Oct. 1960, p. 377-380.

Flask-Tank Setup Now Turns Out First "Bug-Kill-Bug" Insecticide. Perfects a process for manufacture of microbial insecticide that is lethal to leaf-chewing pests, yet nontoxic to plants and animals. *Chemical Engineering,* v. 67, Oct. 3, 1960, p. 42-44.

Microencapsulation Turns to Adhesives. Uses microencapsulation to make premixed adhesives; a few applications should be ready soon. *Chemical and Engineering News,* v. 38, no. 40, Oct. 3, 1960, p. 64 + 1 page.

Chemical Shock-Tube Research. A method of investigating high-temperature gas-phase reactions. ***Victor Kevorkian.*** *Chemical Engineering,* v. 67, Oct. 3, 1960, p. 107-112.

The Engineering Aspects of the Water Vapor Permeability of Glove Materials. ***J. E. Ayer, R. M. Mayfield, and D. R. Schmitt.*** *Nuclear Science and Engineering,* v. 8, Sept. 1960, p. 274-276.

Trickle Process Cleans Up Distillates. Unit hydrodesulfurizes furnace, diesel oils in liquid phase, boasts savings over vapor-treatment routes. *Chemical Engineering,* v. 67, Oct. 3, 1960, p. 76-79.

* **The Scientific Status of Fluoridation.** Discusses the main claims for and against fluoridation. ***J. B. Polya.*** *Royal Australian Chemical Institute, Proceedings,* v. 27, Aug. 1960, p. 354-358.

* **Combination of Apparatus for Mechanical Separation of Solid-Liquid Mixture Systems.** (*In German.*) Kombinationsschaltungen von Apparaten zur mechanischen Trennung festflüssiger Mischsysteme. ***H. F. Trawinski.*** *Chemie-Ingenieur-Technik,* v. 32, Sept. 1960, p. 576-581.

* **Properties of Two-Phase Flow in Rectification in Packed Columns.** Importance of knowing pressure loss of the vapor on flowing through a packing and the liquid content (hold up). The necessary laws for this purpose are set up with the aid of dimensionless indices. (*In German.*) Eigenschaften der Zweiphasen-Strömung bei der Rektifikation in Füllkörpersäulen. ***H. Brauer.*** *Chemie-Ingenieur-Technik,* v. 32, Sept. 1960, p. 585-590.

* **Handling and Distribution of Liquefied Gases.** Discusses unit operations in distribution schemes; unit operations in liquid O distribution; the use of undercooling; and pumping problems. ***T. J. Webster.*** *British Chemical Engineering,* v. 5, Oct. 1960, p. 690-698.

* **Radioactive Tracing of Phenol Losses in Oil Refining.** An investigation carried out at the Fawley Refinery which revealed the sources of loss of an expensive chemical. ***R. E. Pegg, et al.*** *British Chemical Engineering,* v. 5, Oct. 1960, p. 710-713.

* **Some Considerations of Dense-Phase Fluidised Bed Correlations. I.** Worked examples illustrate the use of correlations for calculating the onset of fluidization and bed expansion. ***Max Leva.*** *British Chemical Engineering,* v. 5, Oct. 1960, p. 703-707.

Advances in Cryogenic Engineering. v. I.-V. These five volumes contain proceedings of the Cryogenic Engineering Conferences, National Bureau of Standards, for 1954, 1956, 1957, 1958, and 1959, respectively. The many papers presented cover cryogenic processes, equipment, properties, applications, and bubble chambers. ***K. D. Timmerhaus, editor.*** v. I. 363 pp.; v. II. 369 pp.; v. III. 418 pp.; v. IV. 498 pp.; v. V. 584 pp. 1960. Plenum Press, Inc., New York. (TP480 Ad95)

* **A New Hydrogen Purification Process.** Commercial development of Pd alloy diffusion cells. ***J. B. Hunter.*** *Platinum Metals Review,* v. 4, no. 4, Oct. 1960, p. 130-131.

"Filter Press" Scales Up Electrophoresis. Modified unit uses d.c. field to separate colloids by charge and size, can process liquids commercially. *Chemical and Engineering News,* v. 38, no. 42, Oct. 17, 1960, p. 60 + 1 page.

* **Factors Affecting the Design of Large Sea Water Flash Distillation Plants.** Describes a particular plant which for a single unit will have the largest capacity in the world. ***W. Smith.*** *Water and Water Engineering,* v. 64, Sept. 1960, p. 402-406.

* **How Feasible Is Underground Storage of Liquefied Methane?** ***Donald A. Flanagan and Paul B. Crawford.*** *American Gas Journal,* v. 187, Oct. 1960, p. 34-37.

Tempo Quickens in Fight to Save Water. Attention swings back from "second-front" conversion of saline-to-fresh water and focuses on prime target—better management of existing sources of fresh water. *Chemical Engineering,* v. 67, Oct. 17, 1960, p. 96 + 1 page.

Industry Joins Liquid-Hydrogen Scene. Flow sheet describing commercial production of liquid H. ***N. P. Chopey.*** *Chemical Engineering,* v. 67, Oct. 17, 1960, p. 164-167.

How to Select Pressure-Vessel Size. A practical approach to help size pressure vessels for economical dimensions or to get the optimum size for a vessel having minimum surface area. ***Raymond R. Maccary.*** *Chemical Engineering,* v. 67, Oct. 17, 1960, p. 187-190.

Sulfur Recovery From Petroleum Gases. Eliminates an air-pollution problem and puts a profit in the till. Processes, equipment, and economics. ***Robert A. Graff.*** *Oil and Gas Journal,* v. 58, no. 42, Oct. 17, 1960, p. 118-121.

Kinetics and Mechanism of the Ammonia Synthesis. The reaction rate in stoichiometric mixtures of N and H or deuterium has been measured on two different doubly promoted Fe catalysts. Data show that the rate-determining step is the chemisorption of N on a surface mainly covered with NH radicals. ***A. Ozaki, Hugh Taylor, and M. Boudart.*** *Royal Society, Proceedings,* v. 258, ser. A. Oct. 4, 1960, p. 47-62.

* **The Mechanism of Boiling in the Presence of an Electric Field.** Gives observations of boiling process of dielectric liquids and an analysis of the forces influencing the ebullition nuclei and the movement of the bubbles. Explains the improvement of the exchanges having high thermal powers. As soon as the exchanges increase, the electromechanical action plays a prevalent part as compared with electroconvection forces. (*In French.*) Mécanisme de l'ébullition sous champ électrique. ***Emmanuel Bonjour and Jacques Verdier.*** *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences,* v. 251, no. 7, Aug. 17, 1960, p. 924-926.

* **Pressure Drop of Single Phase Flow Through Raschig Ring Type Tower Packings: Effect of Hole Size.** ***Liang-Tseng Fan.*** *Canadian Journal of Chemical Engineering,* v. 38, no. 5, Oct. 1960, p. 138-141.

* **Fundamental Aspects of Solids-Gas Flow. IV. The Effects of Particle Rotation, Roughness and Shape.** Examines the various complicating effects which rotation, surface roughness and shape impose on the motion and drag of single particles entrained in a fluid. ***L. B. Torobin and W. H. Gauvin.*** *Canadian Journal of Chemical Engineering,* v. 38, no. 5, Oct. 1960, p. 142-153.

Chemical Engineering Progress Symposium Series No. 30. Heat Transfer—Storrs. Thirty papers covering fluid mechanics, heat exchangers, nucleate boiling, condensation, and conductivity of materials. ***Mario T. Cichelli, editor.*** v. LVI. 300 pp. 1960. American Institute of Chemical Engineers, New York. (QC320 Am35he)

* **Flue Dust, Slag, Mill Wastes and Their Industrial Utilization.** Waste utilization was studied from the technical and economic viewpoint. Use of brown coal ashes presents difficulties due to S content. Ordinary coal ashes can be used as additions to cement, due to pozzolana-like qualities. Materials for construction can be prepared from screened ashes and slag granules bonded by cement. Phosphate fertilizer can be obtained from slag. Due to low volume, unsuitable compositions and high water contents, much remains to be done regarding the further use of slimes from coal and ore mining, and metallurgical plants. The over-all picture can be improved by combining different types of wastes. (*In German.*) Flugasche, Schmelzschlacke, Müllschlacke und ihre industrielle Verwertung. ***Rudolf Rasch.*** *Chemiker-Zeitung/Chemische Apparatur,* v. 84, no. 17, Sept. 5, 1960, p. 564-567.

* **Absorption of Hydrogen by Palladium/Platinum Alloys. III. Some Thermodynamic Factors.** Free energies of solution of solution of H and hydride vapor pressures were derived from electrode potential measurements, over a temperature range 0-59 C, as a function of the H content of a series of Pd/Pt alloys. ***A. W. Carson, Ted B. Flanagan, and F. A. Lewis.*** *Faraday Society, Transactions,* v. 56, Sept. 1960, p. 1332-1339.

Monomolecular Films Aid Water Conservation. Straight-chain alcohols form "liquid condensed" films on surfaces of reservoirs to cut down evaporation. *Chemical and Engineering News,* v. 38, no. 39, Sept. 26, 1960, p. 23-25.

* **Dimethylsulfoxide as a Solvent for Inorganic Compounds.** In addition to homeopolar compounds, dimethylsulfoxide dissolves many other compounds of salt-like structure. With inorganic salts it frequently forms crystallized solvates. (*In German.*) Dimethylsulfoxyd als Lösungsmittel für anorganische Verbindungen. ***H. L. Schläfer and W. Schaffernicht.*** *Angewandte Chemie,* v. 72, no. 17, Sept. 7, 1960, p. 618-626.

Multiple-Effect Evaporation, a Graphical Approach. ***W. S. Wise.*** *Industrial Chemist,* v. 36, Sept. 1960, p. 434-436.

* **Insulation for Ultra-Low Temperatures.** Liquid O and methane are two substances which place high demands on choice and design of an insulation system. ***J. W. Dawson.*** *Engineering,* v. 190, Sept. 16, 1960, p. 370-371.

a **Reflectivity of Fatty Acid Monolayers on Water.** The effects of change in wave length and angle of incidence are consistent with the interference theory. Reflectance sensitive to the purity of water used as the film substrate. ***D. T. F. Marple and T. A. Vanderslice.*** *Journal of Physical Chemistry,* v. 64, Sept. 1960, p. 1231-1234.

These Fluids for 500 F and Above. Major types and what they offer in hydraulics and engine oils. ***Annesta R. Gardner.*** *Product Engineering,* v. 31, no. 44, Oct. 24, 1960, p. 45-48.

b * **Studies in Optimization. II. Optimum Temperature Gradients in Tubular Reactors.** ***R. Aris.*** *Chemical Engineering Science,* v. 13, no. 1, Aug. 1960, p. 18-29.

* **Water—in 1980, Our Demand Will Begin to Exceed the Supply.** ***Theodore M. Schad.*** *Better Crops With Plant Food,* v. 44, no. 4, July-Aug. 1960, p. 18-20.

c **Hydrogenating Coal in a Pilot Plant With a Molybdenum Catalyst.** ***Henry H. Ginsberg, et al.*** *U. S. Bureau of Mines Report of Investigations* 5673, 1960, 35 pp. (TN21 Un3r Room 290)

* **Radiochemical Investigation of Ion Exchange on Swelled Exchangers.** A relation has been established between the distribution coefficient of the ions of the radioelement, the specific capacity of the exchanger, and the specific volume of the latter. On the basis of an equation developed for this relation with the aid of two resin specimens of the same specific capacity, and greatly different swelling powers, one can determine the magnitude of the charge of the radioelement in solution. (*In Russian.*) Radiokhimicheskoe issledovanie obmena ionov na nabukhaiushchikh ionitakh. ***A. M. Trofimov and L. N. Stepanova.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 8, Aug. 1960, p. 1837-1842.

d **Extraction Apparatus Used in the Treatment of Irradiated Fuels.** Various types of apparatus designed to this effect are examined: mixer-decanter types with mechanical shaking and with shaking and decantation ultra-sonically accelerated; pulsed columns; hydrocyclones. Some results obtained on radioactive solutions on a pilot scale are given. (*In French.*) Les appareils d'extraction utilisés dans le traitement des combustibles irradiés. ***P. Faugeras and X. Talmont.*** *France, Commissariat a l'Énergie Atomique, Rapport CEA No.* 1427, 1960, 51 pp. (QC770 F84.2r Contin.)

e **Waste Disposal in Salt. I. The HNO_3-NaCl Reaction.** Can be characterized by the production of chlorine and nitrosyl chloride and can be considered to be the same as the aqua regia reaction. ***Hisashi Kubota and Tsuneo Tamura.*** *U. S. Atomic Energy Commission, ORNL-2984,* Oct. 5, 1960, 18 pp. (UF767 U3o Contin.)

f **Industrial Applications of the Metal Organic Compounds.** Includes applications and future possibilities of compounds of Pb, Mn, Cr, and certain of the transition elements. ***J. H. Harwood.*** *Industrial Chemist,* v. 36, Sept. 1960, p. 437-442.

g **High Flow Rate Operation of a Duplex Ion Exchange System.** Results indicate that flow rates substantially higher than those currently recommended are feasible, using filtered Columbia River water as the system influent. ***T. F. Demmitt.*** *U. S. Atomic Energy Commission, HW-65478,* June 2, 1960, 35 pp. (UF767 Un3.1hw Contin.)

h **Treatment of Effluent at the Saclay Centre d'Etudes Nucleaires.** Describes the following: the disposal possibilities at the Centre Saclay, effluents produced at the centre, set-up for collecting effluent, treatment of the effluent, and results of these treatments. (*In French.*) Le traitement des effluents du centre d'etudes nucleaires de saclay. ***G. Wormser.*** *France, Commissariat a l'Énergie Atomique, Rapport CEA No.* 1437, 1960, 15 pp. + 10 plates. (QC770 F84.2r Contin.)

i **Ceramic Fibers for Filtering Dust From Hot Gases.** Laboratory-scale investigations show that an aluminum silicate fiber is suitable for filtering dust from gases at 1800 F. ***L. J. Kane, G. E. Chidester, and C. C. Shale.*** *U. S. Bureau of Mines Report of Investigations* 5672, 1960, 18 pp. (TN21 Un3r Room 290)

j

k

Removing Hydrogen Sulfide by Hot Potassium Carbonate Absorption. Rates of absorption; equilibrium data; solubility of gases in hot carbonate solution; corrosion; pilot-plant results. ***J. H. Field, G. E. Johnson, H. E. Benson, and J. S. Tosh.*** *U. S. Bureau of Mines Report of Investigations* 5660, 1960, 19 pp. (TN21 Un3r Room 290)

a

* **Spontaneous Emulsification.** Various hypotheses for the basis of this phenomenon are put forward, leading to the conclusion that the state of the border separating two liquid phases is far from being fully understood. (*In French.*) Émulsification spontaneé. ***A. Viallard.*** *Chimie & Industrie (Génie Chimique)*, v. 84, no. 3, Sept. 1960, p. 82-88.

b

* **Pressure Drops in Packed Columns. Generalized Method of Estimation for Single Phase Flow.** A procedure to cover all types of single-phase flow is presented for estimating pressure drops by taking into consideration the shape of the individual particle and packing density so that the equation can be used for both expanded or loosely packed and rigidly packed beds with either streamline or turbulent flow. (*In French.*) Pertes de charge dans les colonnes garnies. Méthode généralisée d'évaluation dans le cas d'écoulement á une seule phase. ***R. H. Crowther, R. G. Taecker, and Liang-Tseng Fan.*** *Chimie & Industrie (Génie Chimique)*, v. 84, no. 3, Sept. 1960, p. 73-81.

c

* **The Preparation of Acetylene.** Examines methods of preparation: transformation of hydrocarbons (incomplete combustion of methane), pyrolysis (of propane, butane, or crude petroleum oil constituents), action of the electric arc on methane. (*In French.*) La préparation de l'acétylène. ***Fritz Rosendahl.*** *Chimie & Industrie*, v. 84, no. 3, Sept. 1960, p. 357-374.

d

* **Alkaline Earth Alkylarene Sulphonates.** Studies the use of these products in concentrated liquid detergent compositions employed for washing smooth surfaces (i.e., dishes) and textile materials. They offer interesting prospects, leading to a feasible substantial improvement of the formulas of conventional detergents. (*In French.*) Alkylarènes sulfonates alcalino-terreux. ***Jean-Noël Duperray.*** *Chimie & Industrie*, v. 84, no. 3, Sept. 1960, p. 375-381.

e

* **Forged Steel Flanges.** Review of flanges and facings, with an emphasis on proper application that tells "why" as well as "where". ***E. F. Harrington.*** *Air Conditioning, Heating and Ventilating*, v. 57, Oct. 1960, p. 89-95.

Steam Jet Pump Analysis and Experiments. A study of steam-jet-pump operating characteristics. Nozzle throat pressures are related to inlet water temperature and operating pressure by an empirical expression for the case of a steam-jet pump with a uniform diameter mixing tube. ***Ronald P. Rose.*** *U. S. Atomic Energy Commission, WAPD-TM-227*, June 1960, 121 pp. (UF767 Un3.1wa Contin.)

f

CHEMISTRY—ANALYTICAL

* **The Chromatography of Organic Substances. VII. Determination of Aliphatic Amines by Gas Chromatography.** A method based on the combustion of the components in the elementary analysis combustion furnace and on the conversion of the water obtained into H, which is determined by means of the heat conductivity measuring device, was developed. (*In German.*) Chromatographie Organischer Substanzen. VII. Bestimmung Aliphatischer Amine Durch Gaschromatographie. ***J. Franc and M. Wurst.*** *Collection of Czechoslovak Chemical Communications*, v. 25, no. 9, Sept. 1960, p. 2290-2295.

g

An Electrochemical Determination of Submicrogram Quantities of Molybdenum. By measuring the current produced by reduction of perchloric acid, which is caused by the catalytic effect of Mo under a controlled potential in a supporting electrolyte of 6N $HClO_4$, microgram quantities of Mo can be determined. ***H. E. Palmer.*** *U. S. Atomic Energy Commission, HW-66057*, July 12, 1960, 25 pp. (UF767 Un3.1hw Contin.)

h

The Impurity Analysis of Americium Solutions. Solution d-c arc method developed for the impurity analysis of americium solutions which are from 3-5 Molar in ammonium thiocyanate.

A. J. Johnson and E. Vejvoda. *U. S. Atomic Energy Commission, RFP-194*, Sept. 28, 1960, 28 pp. (UF767 Un3.1rf Contin.)

i

* **Colour Reactions Given by Sugars and Diphenylamine-Aniline Spray Reagents on Paper Chromatograms.** Conditions defined in which mixed acidic diphenylamine-aniline sprays give, on paper chromatograms, specific color reactions with uronic acids, aldoheptoses, methyl pentoses and pentoses. ***R. W. Bailey and E. J. Bourne.*** *Journal of Chromatography*, v. 4, no. 3, Sept. 1960, p. 206-213.

j

* **Determination of Tartaric Acid in Tartaric Materials.** Free and combined tartaric acid in raw tartaric materials is separated by dissolution in *HCl* and treatment with cationic ion exchangers. (*In Italian.*) Dosaggio dell'acido tartarico totale nelle materie tartariche. ***Luigi Giuffrè and Aldo Castoldi.*** *Chimica e l'Industria*, v. 42, Sept. 1960, p. 964-967.

k

Determination of Alkaloid Structures. II. Chemical Methods. Introduction to some of the main chemical degradative methods used in determining alkaloid structures. ***A. W. Sangster.*** *Journal of Chemical Education*, v. 37, Oct. 1960, p. 518-525.

* **The Chelometric Determination of Aluminum, Nickel and Manganese Without Prior Separation.** Hydroxyethylethylenediaminetriacetic acid is used as a selective reagent for the chelometric determination of Al and Ni in the presence of Mn. Manganese is subsequently determined in the same solution by means of a direct EDTA titration. The reagent for the first titrations serves as a masking agent during the Mn determination. Methyl Calcein or Methyl Calcein Blue serves as a metal-fluorechromic indicator for the determinations. ***D. H. Wilkins.*** *Analytica Chimica Acta*, v. 23, no. 4, Oct. 1960, p. 309-311.

* **Determination of Aromatic Primary Amines and Compounds Containing Reactive Methylene Groups by Diazotisation and C-Nitrosation Reaction Using Alkyl Nitrites.** Titrimetric method for the determination of primary aromatic amines and compounds containing a reactive methylene group by diazotization and C-nitrosation. Endpoint is detected potentiometrically with a platinum indicator electrode. ***N. K. Mathur, S. P. Rao, and Dau Narain.*** *Analytica Chimica Acta*, v. 23, no. 4, Oct. 1960, p. 312-316.

Methods for the Determination of Some Trace Elements in Cast Iron. Describes procedures developed for determination of traces of Sb, Bi, Pb, Al, and Co, together with minor modifications made in the light of experience gained during routine use of these methods. Discusses essential differences in technique required for trace analysis, as distinct from normal control analysis, and compares costs of both types of analysis. ***R. C. Rooney.*** *B.C.I.R.A. Journal*, v. 8, no. 5, Sept. 1960, p. 703-716.

* **Quantitative Inorganic Chromatography. VI. Application to Kinetic Studies: The Oxidation of Hydrazine by Ferric Iron in Acid Aqueous Solutions.** ***F. H. Pollard and G. Nickless.*** *Journal of Chromatography*, v. 4, no. 3, Sept. 1960, p. 196-205.

* **Gas-Liquid Chromatography of Allylic Alcohols and Related Branched-Chain Acids.** Relative retention volumes of prenols and of the methyl esters of prenoic acids on columns with polar and non-polar stationary phases with values obtained for the methyl esters of *n*-fatty acids under identical conditions. ***G. Popják and Rita H. Cornforth.*** *Journal of Chromatography*, v. 4, no. 3, Sept. 1960, p. 214-221.

* **Titration of Cerium(IV) Sulphate With Sodium Oxalate at the Room Temperature Using Ferroin as Internal Indicator.** New principle utilized for facilitating the indicator action at the equivalence point. Involves the use of a photochemical reaction between the oxalate and iron(III) which is deliberately added to the mixture containing cerium(IV) sulfate and ferriin. ***V. Panduranga Rao, P. V. Krishna Rao, and G. Gopala Rao.*** *Zeitschrift für Analytische Chemie*, v. 176, no. 5, 1960, p. 333-336.

* **A New Spectrophotometric Method for the Micro Determination of Sulfuric Acid Esters in Sulfatide Fractions.** Sulfuric acid ester absorption is measured at 8.02 μm by infrared spectrophotometry, compared with that of a standard sulfatide, and corrected for phosphorus. Discusses general problems in

measuring sulfatides; procedural details, control studies, advantages, and limitations of the present method. ***Frank J. Witmer and James H. Austin.*** *Mikrochimica Acta,* 1960, no. 4, p. 502-509.

*** Sensitive New Test for Aliphatic, Aromatic, and Heterocyclic Aldehydes.** A new sensitive spot test is introduced. Limits of identification for over 70 aldehydes are recorded. All tested aldehydes except chloral and hexadecanal give positive tests revealed by a blue or a green color. For the determination of total aldehyde, the procedure is at best an estimation. ***Eugene Sawicki and Thomas W. Stanley.*** *Mikrochimica Acta,* 1960, no. 4, p. 510-517.

*** Metal Precipitation With Aliphatic Arsonic Acids.** Describes the analytical behavior of ethyl-, *n*-propyl-, and *n*-butyl arsonic acids toward a number of metal ions. The mode of action of the individual acids is compared. (*In German.*) Metallfällungen mit aliphatischen Arsonsäuren. ***R. Pietsch.*** *Mikrochimica Acta,* 1960, no. 4, p. 539-552.

*** Complexometric Analysis. III. The Analysis of Metals in Mixtures.** ***J. A. R. Genge.*** *Laboratory Practice,* v. 9, Oct. 1960, p. 716-718.

The Determination of Uranium in Impure Solutions Using an Electron Bombardment-Type Mass Spectrometer. A method is presented for the determination of U and U-235 in miscellaneous impure samples by use of a mass spectrometer utilizing an electron bombardment-type ion source. The method consists of adaptations of isotopic dilution techniques which have been widely used in other analytical methods and with other instrumentation. Data are presented showing comparisons of results obtained by chemical and fission-counting analytical techniques. The definite advantage of better precision on isotopic analysis is realized. There is a real possibility that better precision in the determination of U may be obtained with further experience and refinements in this technique. ***C. D. Tabor, G. F. Kauffman, and F. S. Voss.*** *U. S. Atomic Energy Commission, GAT-292,* Sept. 1, 1960, 11 pp. (UF767 Un3.1ga Contin.)

On the Paper Adsorption Chromatographic Phenomena. Presents a mathematical analysis of an equilibrium adsorption paper chromatography system. Shows the gross features of the chromatographic phenomena such as the movement of the solvent front and the separation of the solute bands. The diffusion model for solvent penetration yields an experimentally obtained correlation. ***Dale F. Rudd.*** *Journal of Physical Chemistry,* v. 64, Sept. 1960, p. 1254-1256.

Ultracentrifugal Determination of the Micellar Character of Non-Ionic Detergent Solutions. An analytical ultracentrifuge was used to determine the micellar molecular weights of micelles in four aqueous nonionic detergent solutions at 25 C. Transient state methods were used extensively, and capillary synthetic boundary cells were used to determine relative optical concentrations. Molecular weights were determined for various times and concentrations to ensure accuracy. Three polyoxyethylated phenols formed micelles containing 100-300 molecules while Pluronic L-64, a high molecular weight condensate of ethylene and propylene oxides, does not exhibit micelle formation. ***C. W. Dwiggins, Jr., R. J. Bolen, and H. N. Dunning.*** *Journal of Physical Chemistry,* v. 64, Sept. 1960, p. 1175-1178.

The Use of Radioactivity in Particle Size Determination. An outline of the limitations of conventional methods of particle size determination, and a description of the manner in which radioactive techniques can be used in the solution of this problem and the advantages which can accrue from their adoption. ***P. Connor and W. H. Hardwick.*** *Industrial Chemist,* v. 36, Sept. 1960, p. 427-433.

*** Paper Chromatography of Synthetic Dyes.** General techniques and specific examples of suitable methods for disperse, acid, direct and metal-complex dyes are given. Methods of extracting dyes from various textile fibers are given. The complex nature of many commercial dyes is discussed in relation to methods of manufacture. ***J. C. Brown.*** *Society of Dyers and Colourists, Journal,* v. 76, Sept. 1960, p. 536-542 + 6 plates.

The Fluorescence Spectra of Aromatic Hydrocarbons and Heterocyclic Aromatic Compounds. Application of fluorescence spectroscopy in the qualitative and quantitative analysis of

aromatic compounds. ***Benjamin L. Van Duuren.*** *Analytical Chemistry,* v. 32, Oct. 1960, p. 1436-1442.

a *** New Colorimetric Applications of the Chromate-*o*-Dianisidine System. I. Indirect Colorimetric Determination of Antimony(III), Hyposulfite, Hydrazine, Hydroxylamine and Hydrogen Peroxide. II. Indirect Colorimetric Determination of Some Mercapto Compounds: Thioglycolic Acid, Thiolactic Acid and Thiomalic Acid.** ***F. Buscarons, J. Artigas, and C. Rodriguez-Roda.*** *Analytical Chimica Acta,*

b v. 23, no. 3, Sept. 1960, p. 214-218.

*** Polarographic Analysis. II. Polarography of Uranium in Sulphate Solutions. III. Polarographic Behaviour of Uranium in Phosphoric Acid Solutions.** ***I. M. Issa, R. M. Issa, and Laila A. Shalaby.*** *Zeitschrift für Analytische Chemie,* v. 176, no. 4, 1960, p. 250-264.

c *** The Determination of Small Amounts of Arsenic in Organic Matter.** Molybdenum-blue method is recommended since it is spectrophotometric determination, and thus has inherent advantages over the Gutzeit method, which may be regarded as an estimation rather than a determination. *Analyst,* v. 85, Sept. 1960, p. 629-643.

d *** The Effect of Substituent Groupings on the Chromatographic Behaviour of Phenoxyacetic Acids. I. Methyl-Substituted Phenoxyacetic Acids.** Paper chromatograms for 13 methyl-substituted phenoxyacetic acids were run in two solvent mixtures, the conditions being rigorously standardized. ***L. S. Bark and R. J. T. Graham.*** *Analyst,* v. 85, Sept. 1960, p. 663-666.

e **Mass Spectra of Aromatic Esters.** Mass spectra of seven homologous series of aromatic esters were correlated with molecular structures. Mass spectra can be used for the identification of unknown esters and the analysis of these esters in mixtures. ***E. M. Emery.*** *Analytical Chemistry,* v. 32, Oct. 1960, p. 1495-1506.

f **The Spectrographic Determination of Trace Elements in Clays With the D.C. Carbon Arc.** Procedure is based on the hollow electrode method and uses the sample-containing electrode as anode. The following elements are determined: B, Ba, Be, Cr, Cu, Mn, Ni, Pb, Sn, Sr, V, Y, Zr and also the secondary elements Ca, Mg, Fe, and Ti. Deals with: apparatus, electrodes, preliminary experiments, electrode consumption, choice of elements for analysis and standardization, preparation of standards, evaluation, calibration curves, sensitivity, and analysis

g examples. (*In German.*) Die spektrographische Bestimmung der Spurenelemente in Tonen mit dem Gleichstrom-Kohlelichtbogen. ***F. Hegemann, H. Kostyra, and J. Kostyra.*** *Deutsche Keramischen Gesellschaft, Berichte,* v. 37, Aug. 1960, p. 372-377.

h **Spectrophotometric Determination of Technetium(VII) With Thioglycolic Acid.** Spectrophotometric method developed to supplement the radio-chemical and polarographic methods. ***F. J. Miller and P. F. Thomason.*** *Analytical Chemistry,* v. 32, Oct. 1960, p. 1429-1430.

CHEMISTRY—INORGANIC AND GENERAL

i *** Studies on Metallic Halide Dioxanates. III. Dioxanates of Cobalt (ii) and Nickel (ii) Chlorides.** Method of isolation, characterization and stability of cobalt and nickel chloride monodioxanates. A stable, lower dioxanate of each of these chlorides has also been isolated. ***Sosamma Chandy and S. S. Moosath.*** *Indian Academy of Sciences, Proceedings,* v. 52, sec. A, no. 2, Aug. 1960, p. 58-62.

j **Cuprous Halide Films on Alkali Halide Crystals.** Films of cuprous halides were formed by evaporation and condensation in a vacuum onto substrates of alkali halide crystals at room temperature. They were annealed for 15-min periods at temperatures between 60 and 150 C. Optical absorption spectra indicate that the annealing causes diffusion of CuCl and CuBr into KCl and KBr, but not into KI or NaCl, and of CuI into

k RbI, but not into KCl, KBr, KI, or NaCl. An interstitial mechanism for diffusion is consistent with the data, but is not sufficient to account for the behavior of CuI. ***L. M. Kraemer.*** *Journal of Chemical Physics,* v. 33, Oct. 1960, p. 991-993.

Heat of Formation of Yttrium Chloride. ***R. L. Montgomery and T. D. Hubert.*** *U. S. Bureau of Mines Report of Investigations* 5659, 1960, 10 pp. (TN21 Un3r Room 290)

*** Contributions to the Chemistry of the Elements Niobium and Tantalum. XXIII. The Thermochemistry of the Niobium Chlorides.** The heats of formation of the solid chlorides $NbCl_5$ and $NbCl_4$ have been determined from calorimetric measurements of the heats of solution. The ΔH-values for the gaseous compounds $NbCl_5$ and $NbCl_4$, for the upper and lower limits of the trichloride phase $NbCl_{3.18}$ and $NbCl_{2.67}$, and for $NbCl_2$ were determined on the basis of further experimental investigations. (*In German.*) Beiträge zur Chemie der Elemente Niob und Tantal. XXIII. Die Thermochemie der Niobchloride. ***Harald Schäfer and Franz Kahlenberg.*** *Zeitschrift für Anorganische und Allgemeine Chemie,* v. 305, nos. 5-6, Aug. 1960, p. 291-326.

*** Production of Rhenium Hexafluoride by Fluorination of the Metal With Chlorine Trifluoride.** For the neutralization of 1 g of ReF_6 after hydrolysis and oxidation according to the equation $2\ ReF_6 + 14\ KOH + H_2O_2 = 2KReO_4 + 12KF + 8H_2O$, 0.233 of alkali equivalent is necessary. For 1 g of ReF_6 obtained, 0.234 of the equivalent was used. In the aliquote parts of the solution, Re is determined in the form of nitron perrhenate and fluorine by titrating with a $AlCl_3$ solution. (*In Russian.*) O poluchenii geksaftorida reniia ftorirovaniem metalla triftoridom khlora. ***N. S. Nikolaev and E. G. Ippolitov.*** *Akademiia Nauk SSSR, Doklady,* v. 134, no. 2, Sept. 1960, p. 358-359.

*** Formation of Tantalum Iodides.** Ta in powder form, 97.8% pure, and "ch" iodine were used. The initial elements were thoroughly purified. Ta was degasified by heating to 400 C with continuous evacuation of the gases with a residual pressure of 0.05-0.01 mm of the Hg column during 3 to 4 hours. Iodine was purified by sublimation. Some properties of Ta obtained by the thermal dissociation of its iodides were determined. (*In Russian.*) Obrazovanie ĭodidov tantala i ĭodidnyĭ tantal. ***D. M. Chizhikov and B. I. Rabinovich.*** *Akademiia Nauk SSSR, Doklady,* v. 134, no. 2, Sept. 1960, p. 368-370.

Reports on the Progress of Applied Chemistry. Discusses fuel and power; organic chemistry; biological products; chemical engineering; agriculture and food; inorganic chemistry; textiles; plastics. ***H. S. Rooke, editor.*** v. XLIV. 705 pp. 1959. Society of Chemical Industry, London. (TP1 So13r Vis.)

A Possible Structure of μ-Peroxocomplexes of Cobalt. On the basis of considerations of the steric arrangements of cobalt μ-peroxocomplexes, a structure has been proposed, containing the O_2-group situated perpendicularly to Co-Co internuclear axis. ***A. A. Vlček.*** *Faraday Society, Transactions,* v. 56, Aug. 1960, p. 1137-1143.

The Preparation, Structures and Infrared Absorption of Salts of Cobalt(III) Hexafluoride Ion. X-ray and infrared studies of K_2NaCoF_6, K_3CoF_6, Na_3CoF_6, Li_3CoF_6 and $Ba_3[CoF_6]_2$ lead to the conclusion that only the first is rigorously cubic, whereas the remaining ones show increasing distortion of the lattice and the CoF_6^{-3} octahedra in the order listed. ***M. D. Meyers and F. A. Cotton.*** *American Chemical Society, Journal,* v. 82, Oct. 5, 1960, p. 5027-5030.

γ-Ray Induced Oxidation of Stannous Chloride in Aqueous Hydrochloric Acid Solutions. γ-Ray induced oxidation of Sn(II) in aqueous hydrochloric acid solutions is independent of the concentration of Sn(II), concentration of Sn(IV) and irradiation time. The "G"-values found in 3 *N* HCl are 1.50 Sn(II)/100 e.v. This value is independent of acid concentration above 1.5 *M* but decreases at lower acid concentrations. There is a slight dependence of *G* upon concentration of chloride. This is postulated as being related to changes in activity and oxidation potentials. The mechanism of the reaction is postulated using previously reported reactions. ***Alexander R. Amell.*** *Journal of Physical Chemistry,* v. 64, Sept. 1960, p. 1277-1279.

Thermal Decomposition of Uranyl Sulfate. Results of a study, by means of differential thermal analysis (DTA) and thermogravimetric analysis (TGA), of: the general nature of the thermal decomposition of UO_2SO_4, the kinetics of the decomposition, and certain aspects of the decomposition equilibrium. ***Karl J. Notz, Jr.*** *U. S. Atomic Energy Commission, NLCO-814,* Sept. 8, 1960, 48 pp. (UF767 Un3.1nL Contin.)

Chemistry of Some Hydrolyzed Cr III Polymers. Two polynuclear Cr-III species were isolated from refluxed chromic perchlorate and chromic nitrate solutions. Evidence of chromic perchlorate complexing within the resin of these species was found. Similiar studies which indicated perchlorate complexing of Fe III, Ce III, Th IV, and La III within the resin were also made. ***James Edgar Finholt.*** *U. S. Atomic Energy Commission, UCRL-8879,* Apr. 16, 1960, 66 pp. (UF767 U3u Contin.)

CHEMISTRY—ORGANIC

*** Structure of the Products of Condensation of Formaldehyde and Phenyl Hydrazine.** Both compounds produce condensation products in the following proportions: 1:1, 3:2, and 4:2. Three condensation products belong to the hexahydrotetrazine series; two of them are of a type so far unknown of bridged tetrazine. One compound is a tetrahydrotriazine derivative which must be derived from Weygand intermediate product of the osazone formation by forming a ring with formaldehyde. (*In German.*) Struktur der Kondensationsprodukte aus Formaldehyd und Phenylhydrazin. ***Ernst Schmitz and Roland Ohme.*** *Annalen der Chemie (Justus Liebigs),* v. 635, nos. 1-3, Sept. 1960, p. 82-91.

*** A Contribution to the Conversion of Formaldehyde Into Carbon Hydrates.** In the alkaline field, from formaldehyde first glycolaldehyde(I) is formed which, in the presenec of $CaCO_3$ reacts with CH_2O into dihydroxiacetone, which with I results into ribulose exclusively. By adding CaO, I is dimerised into tetroses, from which 2 molecules pass into 1 mole II and one mole of pentose, respectively. Hexoses are produced also. The reaction process is discussed and verified by paper chromatography. (*In German.*) Zur Umwandlung von Formaldehyd in Kohlenhydrate. ***Roland Mayer and Lothar Jäschke.*** *Annalen der Chemie (Justus Liebigs),* v. 635, nos. 1-3, Sept. 1960, p. 145-153.

Trialkyl Phosphite Borines. A New Type of Phosphorus-Boron Compound. Properties and methods of preparation. ***Theodor Reetz.*** *American Chemical Society, Journal,* v. 82, Oct. 5, 1960, p. 5039-5042.

Hexaalkyl Phosphorous Triamide Borines. Methods of preparation and properties are given. Reactivity of the hexaalkyl phosphorous triamide borines is lower than that of trimethylamine borine. ***Theodor Reetz and B. Katlafsky.*** *American Chemical Society, Journal,* v. 82, Oct. 5, 1960, p. 5036-5039.

Base-Initiated Dehydrohalogenation and Rearrangement of 1-Halo-2,2-Diphenylethylenes in *t*-Butyl Alcohol. The Effect of Deuterated Solvent. ***J. G. Pritchard and A. A. Bothner-By.*** *Journal of Physical Chemistry,* v. 64, Sept. 1960, p. 1271-1277.

The Gaseous Oxidation of Aliphatic Alcohols. III. *n*- and *iso*-Propyl Alcohols. A study of the gaseous oxidation of *n*-propyl alcohol (1-propanol) at 264 C shows that, after an induction period during which higher aldehydes and hydrogen peroxide are apparently the only products formed, the pressure starts to rise autocatalytically and methanol, formaldehyde and carbon monoxide become detectable. Isopropyl alcohol (2-propanol) is much less readily oxidized than 1-propanol. At 330 C the main oxidation product is acetone which is formed together with hydrogen peroxide in somewhat smaller quantities. ***C. F. Cullis and E. J. Newitt.*** *Royal Society, Proceedings,* v. 257, ser. A, Sept. 20, 1960, p. 402-412.

*** The Formation of Polycyclic Aromatic Hydrocarbons and Carbon Deposits From Normal and Reversed Diffusion Flames.** Quantitative study of the hydrocarbon content of the deposits from diffusion flames using a wide variety of gaseous and liquid fuels. ***A. J. Lindsey.*** *Combustion and Flame,* v. 4, no. 3, Sept. 1960, p. 261-264.

*** Steroidal Sapogenins. LXII. 12-Methyl Hemiketals Derived From 12-Keto-16-Dehydropregnenes.** Large-scale degradation of the sidechains of the 12-ketosapogenisn, hecogenin and gentrogenin, gave respectively 3β-acetoxy-5α, 16-pregnene-12,20-dione and 3β-acetoxy-5,16-pregnadiene-12,20-dione. The

hemiketals exist largely in a hydrogen-bonded state. Their structure proof and infrared and ultraviolet spectra are discussed in detail. ***M. E. Wall and S. Serota.*** *Tetrahedron*, v. 10, nos. 3-4, Aug. 1960, p. 238-243.

* **Toxic Fluorine Compounds Containing the C—F Link. XI. Lability of the Fluorine Atom in 2-Fluoroethanol.** Shows that 2-fluoroethanol, often described as a chemically unreactive compound, will react with a number of nucleophilic reagents. ***D. L. E. Bronnert and B. C. Saunders.*** *Tetrahedron*, v. 10, nos. 3-4, Aug. 1960, p. 160-163.

* **Diquinones. I. The Oosporein-Tomichaedin Degradation.** It is established, by synthesis, that tomichaedin, the degradation product obtained from the dibenzoquinone, oosporein, by fusion with potash, has the structure 3-hydroxy-2-methyl-1,4-naphthaquinone-6-carboxylic acid. A mechanism for the reaction is proposed which accounts for all the products which were isolated. ***J. Smith and R. H. Thomson.*** *Tetrahedron*, v. 10, nos. 3-4, Aug. 1960, p. 148-152.

* **Liquid Scintillators. X. Some Aryl Substituted Phenanthrenes and Dihydrophenanthrenes, and Related *p*-Terphenyls and *p*-Quaterphenyls Determination of Kallman Parameters.** ***Stephen P. Birkeland, Guido H. Daub, F. Newton Hayes, and Donald G. Ott.*** *Zeitschrift für Physik*, v. 159, no. 5, 1960, p. 516-523.

Intramolecular Free Radical Arylation and Related Reactions. A study was made of the reactions of the 2-*o*-terphenyl free radical as obtained both from the peroxide of *o*-terphenyl-2-carboxylic acid and from the diazonium salt derived from 2-amino-*o*-terphenyl. Cyclization to triphenylene occurs to the exclusion of the intermolecular reaction with benzene or with carbon tetrachloride. However, bromine abstraction from bromotrichloromethane does compete with cyclization. This behavior is in contrast to that of the *o*-benzoylphenyl radical, which was found in previous work to give a higher yield of 2-phenylbenzophenone by intermolecular reaction with benzene than of the intramolecular cyclic product, fluorenone. The peroxide of *o*-(1-naphthyl)-benzoic acid (VI) was also investigated, but the acyloxy radical failed to decarboxylate. The main product found was the lactone VIII of *o*-(2-hydroxy-1-naphthyl)-benzoic acid. ***DeLos F. DeTar and Chin-Chiun Chu.*** *American Chemical Soicety, Journal*, v. 82, Sept. 20, 1960, p. 4969-4974.

Oxidation of Isobutylene With Dinitrogen Tetroxide. Good yields of the α-hydroxyisobutyric acid (69-74%) were obtained when isobutylene was added to excess dinitrogen tetroxide or to a nitric acid solution of dinitrogen tetroxide at about 0° and the resulting mixture was allowed to undergo oxidative and hydrolytic reactions. ***Erwin F. Schoenbrunn and James H. Gardner.*** *American Chemical Society, Journal*, v. 82, Sept. 20, 1960, p. 4905-4908.

The Alkali Metal Catalyzed Alkylation of Toluene With Propylene. The alkylation of toluene with propylene in the presence of Li, Na, and K catalysts was studied over a range of temperatures from 100 to 300°. The principal product is isobutylbenzene, but abnormal addition to form *n*-butylbenzene is an important side reaction. ***R. M. Schramm and G. E. Langlois.*** *American Chemical Society, Journal*, v. 82, Sept. 20, 1960, p. 4912-4918.

Pyrolysis of β-Hydroxyolefins. III. A Novel Method for Extending Carbon Chains. The method is based upon the synthesis of 2-(1′-alkenyl)-cycloalkanols which, when pyrolyzed at temperatures near 500°, yield long open-chain, unsaturated, carbonyl compounds. ***Richard T. Arnold and Gerald Smolinsky.*** *American Chemical Society, Journal*, v. 82, Sept. 20, 1960, p. 4918-4920.

Chemistry of Ethylenimine. VII. Cycloöctenimine or 9-Azabicyclo [6.1.0] nonane. VIII. Sterospecificity in the Pyrolytic Rearrangement of 1-(*p*-Nitrobenzoyl)-2-benzylaziridine. ***D. V. Kashelikar and Paul E. Fanta.*** *American Chemical Society, Journal*, v. 82, Sept. 20, 1960, p. 4927-4931.

Terephthalic Acid by Isomerisation and Disproportionation. ***Peter W. Sherwood.*** *Chemistry & Industry*, 1960, no. 35, Aug. 27, p. 1096-1100.

New Uses for Coal Acids. Coal acids give: solutions of workable viscosity and good film-forming properties for warp sizing; a wide spectrum of thermosetting resins with varying properties; and outstanding mold-release compounds for foundries. ***Wesley L. Archer, Robert S. Montgomery, Keith B. Bozer, and James B. Louch.*** *Industrial and Engineering Chemistry*, v. 52, Oct. 1960, p. 849-852.

Terephthalic Acid by Single-Stage Oxidation. p-Xylene can be oxidized to give high yields of terephthalic acid under mild conditions, using a Co catalyst and a ketone activator system. ***William F. Brill.*** *Industrial and Engineering Chemistry*, v. 52, Oct. 1960, p. 837-840.

Structure of the 1:1-Adducts of Cupric β-Diketone Chelates With Heterocyclic Bases. ***D. P. Graddon and E. C. Watton.*** *Nature*, v. 187, Sept. 17, 1960, p. 1021-1022.

* **Fungus Pigments. XII. The Structure and Synthesis of Thelephoric Acid.** Degradative and spectroscopical evidence, as well as biogentic considerations led to the conclusion that thelephoric acid is 2,3,8,9,-tetrahydroxybenzobis[1,2-b,4,5-b′]-benzofuran-6,12-quinone(VI). This view was confirmed by synthesis, involving condensation of chloranil with two molecules of 3,4-dimethoxyphenol and subsequent demethylation. ***J. Gripenberg.*** *Tetrahedron*, v. 10, nos. 3-4, Aug. 1960, p. 135-143.

* **Isotopic Exchange of Nitrogen in Amides of Acids.** The effects of the substitutes and of the formation of the radical on the speed of exchange of the amino groups in amides of acids with ammonia without addition and in the presence of NH_4Cl as an acid catalyst were studied. Up to 4.5*N* NH_4Cl the speed constant increases linearly; it decreases during further increase of the acidity. (*In Russian.*) Izotopnyĭ obmen azota v amidakh kislot. ***L. L. Gordienko and A. I. Brodskiĭ.*** *Akademiia Nauk SSSR, Doklady*, v. 134, no. 3, Sept. 1960, p. 595-598.

* **Phenol and Cyclohexanone From Cycloexylbenzene.** Cyclohexylbenzene oxidized to cyclohexylbenzene hydroperoxide by pure O_2. The product decomposed to phenol and cyclohexanone. (*In Italian.*) Fenolo e cicloesanone da cicloesilbenzene. ***G. Caprara and G. Lemetre.*** *Chimica e l'Industria*, v. 42, Sept. 1960, p. 974-977.

Heterocyclic Compounds From Urea Derivatives. I. A New Synthesis of 3-Amino-5-mercapto(and -hydroxy)-1,2,4-triazoles. Synthesis by condensation of isothiocyanic esters with aminoguanidine in ketonic solvents containing an equivalent of Na, or with the corresponding hydrazones in pyridine. ***Leonard E. A. Godfrey and Frederick Kurzer.*** *Chemical Society, Journal*, 1960, Sept., p. 3437-3444.

The Oxidation of Unsaturated Acetals and Acylals With Peracetic Acid. Series of unsaturated dioxolanes, acetals, and acylals based on α,β-unsaturated aldehydes were prepared and oxidized with peracetic acid. Major products in most cases were the anticipated epoxides. ***Donald L. Heywood and Benjamin Phillips.*** *Journal of Organic Chemistry*, v. 25, Oct. 1960, p. 1699-1703.

Ketones as Catalysts in the Reduction of Aromatic Nitrogen Compounds. Aromatic ketones in the methanolic sodium hydroxide reduction of *o*-nitrotoluene has considerably improved the yields of the desired azoxytoluene. ***Adnan A. Sayigh.*** *Journal of Organic Chemistry*, v. 25, Oct. 1960, p. 1707-1709.

* **By-Products of 2-Methyl-5-vinylpyridine.** Studies the by-products of the 2-methyl-5-vinyl-pyridine synthesis via 2-methyl-5-ethylpyridine dehydrogenation. Separation of these by-products was realized by gas chromatography. (*In Italian.*) Sottoprodotti della sintesi della 2-metil-5-vinilpiridina. ***G. B. Gechele, A. Nenz, C. Garbuglio, and S. Pietra.*** *Chimica e l'Industria*, v. 42, Sept. 1960, p. 959-964.

* **Catalytic Decomposition of Di-n-butylsulfide on α-Fe.** Di-n-butylsulfide decomposes in the presence of reduced α-iron at 300-400° with the formation of gaseous products, namely, unsaturated and saturated hydrocarbons and H_2. The apparent activation energy is 12.7 kcal/mole. In the presence of H_2 in additon to the above compounds, H_2S also forms. Hydrogen regenerates the catalyst and hydrolyzes the C–S and C–C

bonds, as was confirmed by gas analysis. The apparent activation energy is 10 kcal/mole. The catalytic decompostion of sulfide and mercaptan is accompanied by the formation of FeS_{1+x}, where $\chi < 1$. This was proved by thermomagnetic, X-ray and chemical analyses. (*In Russian.*) Kataliticheskoe razlozhenie di-n-butilsul'fida na α-Fe. ***A. A. Balandin, A. I. Kukina, and E. A. Malakhova.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 9, Sept. 1960, p. 2030-2040.

Temperature Dependence of the Rates of Addition of Oxygen Atoms to Olefins. Relative rates of addition of O atoms to several representative olefins were measured at 25 to 125 C, and the ratios of the pre-exponential factors and differences in activation energies were calculated from the mean values of the relative rate constants at the two temperatures. The results obtained show that the differences in reactivities are primarily due to differences in the activation energies, while the pre-exponential factors remain approximately constant. ***R. J. Cvetanović.*** *Journal of Chemical Physics,* v. 33, Oct. 1960, p. 1063-1068.

* **Investigation in the Domain of Boron Compounds. New Derivatives of Triallyl Boron.** The production of di-n-propyl allyl boric acid, di-n-amyl allyl boric acid, dibenzyl allyl boric acid, diphenyl allyl boric acid, the reaction of triallyl boron with benzoic acid and with n-butyric acid, with propionic aldehyde, with benzaldehyde, and with butyric aldehyde were studied. (*In Russian.*) Issledovaniia v oblasti soedinenii bora. Novye proizvodnye triallilbora. ***A. V. Topchiev, Ia. M. Paushkin, A. A. Prokhorova, E. L. Frenkin, and M. V. Kurashev.*** *Akademiia Nauk SSSR, Doklady,* v. 134, no. 2, Sept. 1960, p. 364-367.

Organic Constituents of Gelatins and Glues. I. Heat-Coagulable Mucoprotein Components From Gelatins. Components isolated from acid and lime-processed gelatins by a heat denaturation and coagulation technique are shown to be mucoproteins contaminated with smaller amounts of gelatin and lipid, and probably having their origin in the alkali-soluble mucoproteins of the connective tissues used for the manufacture of the gelatins. Differences in amino-acid composition of the isolated materials are noted. From comparisons of these with materials isolated by other techniques, it is concluded that at least two types of mucoproteins are found in gelatins; one of these originates from the alkali-soluble mucoproteins of the connective tissues, and the other from materials similar to the acetic-acid-soluble fraction from connective tissue not precipitated by NaCl. ***A. A. Leach.*** *Journal of Applied Chemistry,* v. 10, pt. 9, Sept. 1960, p. 367-372.

Substituent Interactions in *ortho*-Substituted Nitrobenzenes. I—III. I, III. ***J. D. Loudon and I. Wellings.*** II. ***J. D. Loudon and G. Tennant.*** *Chemical Society, Journal,* 1960, Sept., p. 3462-3473.

* **Hydroboration of β-Pinene.** Myrtanol, isomyrtanol, or any desired mixture of the two can be obtained by the anti-Markownikoff hydration of β-pinene by proper control of the hydroboration conditions. ***J. C. Braun and G. S. Fisher.*** *Tetrahedron Letters,* 1960, no. 21, Sept., p. 9-11.

New Heteroaromatic Compounds. VII. Chloro and Bromo Derivatives of 10-Hydroxy-10,9-borazarophenanthrene. ***Michael J. S. Dewar and Ved P. Kubba.*** *Journal of Organic Chemistry,* v. 25, Oct. 1960, p. 1722-1724.

Synthesis and Reactions of 5-Bromomethyl- and 5-Chloromethyluracil. ***John A. Carbon.*** *Journal of Organic Chemistry,* v. 25, Oct. 1960, p. 1731-1734.

Organic Polysulfides. II. Polymorphism in Dibenzhydryl Tetrasulfide. Two polymorphs of dibenzhydryl tetrasulfide were found. Observations of mutual convertibility and of their melting behaviors, and determinations of ultraviolet and infrared absorption spectra, support the conclusion that the two forms are rotational isomers in the solid state. ***Jitsuo Tsurugi and Takeshige Nakabayashi.*** *Journal of Organic Chemistry,* v. 25, Oct. 1960, p. 1744-1747.

* **Configuration of Saturated Cyclic Systems Investigated by Means of Nuclear Magnetic Resonance. 2-Methyl-1-oxycyclohexylethyleneoxides and Certain 1-Oxydecalylethyleneoxides.** (*In Russian.*) Issledovanie konfiguratsii nasyshchennykh tsiklicheskikh sistem metodom iadernogo magnitnogo rezonansa. 2-metil-1-oksitsiklogeksiletilenoksidy i nekotorye 1-oksidekaliletilenoksidy. ***J. I. Musher and A. A. Akhrem.*** *Akademiia Nauk SSSR, Doklady,* v. 134, no. 2, Sept. 1960, p. 354-357.

Conformations of the Pyranoid Sugars. III. Infrared Absorption Spectra of Some Acetylated Aldopyranosides. Spectra of twenty-four acetylated aldopyranosides in the range of 5,000 to 250 cm^{-1}. ***R. Stuart Tipson and Horace S. Isbell.*** *U. S. National Bureau of Standards, Journal of Research, Section A, Physics and Chemistry,* v. 64A, no. 5, Sept.-Oct. 1960, p. 405-426.

* **One Step Synthesis of Perchloroethylene From 1,1,2,2-Tetrachloroethane. II. Vapor-Phase Thermal Chlorination of Trichloroethylene, Perchloroethylene, and 1,1,2,2-Tetrachloroethane, With Chlorine Gas.** Reaction velocities for the thermal chlorination of trichloroethylene were 20 at 350 C, 30 at 400 C, and 70 at 450 C; and reaction velocities for the thermal chlorination of perchloroethylene were 6-8 at 350 C, 10 at 400 C, and 15 at 450 C. (*In Japanese.*) ***Juichi Imamura and Nobuto Ohta.*** *Government Chemical Industrial Research Institute, Tokyo, Reports,* v. 55, Aug. 1960, p. 287-294.

* **The Mechanism of Isotope Exchange Reactions of Dialkylmercury and Alkylmercuric Halides.** ***O. A. Reutov, T. P. Karpov, E. V. Uglova, and V. A. Malyanov.*** *Tetrahedron Letters,* 1960, no. 19, Aug., p. 6-15.

Novel Heterocyclopentadienes. II. Dimerization of diphenylacetylene by lithium metal was shown to yield an active dilithium compound which may be used in the preparation of heterocyclic materials by condensation with metallic (or metalloid) dihalides. ***F. C. Leavitt, T. A. Manuel, F. Johnson, L. U. Matternas, and D. S. Lehman.*** *American Chemical Society, Journal,* v. 82, Oct. 5, 1960, p. 5099-5102.

The Addition of Methylene to Cyclobutane and the Decomposition of Excited Methylcyclobutane. Photolysis of ketene and diazomethane in the presence of cyclobutane. Methylene formed by the photolysis adds to the cyclobutane to give a highly excited molecule of methylcyclobutane. ***H. M. Frey.*** *Faraday Society, Transactions,* v. 56, Aug. 1960, p. 1201-1210.

The Photosensitized Isomerization of Butene-2. Mercury photosensitized cis-trans isomerization of butene-2. All the features of the reaction are explained by the production of vibrationally excited triplet states. Photosensitized isomerizations brought about by benzene, sulfur dioxide and other molecules were also examined. ***R. B. Cundall and T. F. Palmer.*** *Faraday Society, Transactions,* v. 56, Aug. 1960, p. 1211-1224.

* **Studies Concerning the Substitution Process. XIX. The Reaction of the Cyclic Phthalyl Peroxide With Amines, Phosphines, Thioethers and Sulphosides. XX. Double and Multiple Chlorination of Some Monochloroalkanes. XXI. Kinetics and Mechanism of the Chlorination of Some Aliphatic Ethers.** (*In German.*) Studien zum Ablauf der Substitution. XIX. Die Reaktion von Cyclischem Phthalylperoxyd mit Aminen, Phosphinen, Thioäthern und Sulfoxyden. XX. Zweit- und Mehrfach-Chlorierung Einiger Monochloralkane. XXI. Kinetik und Mechanismus der Chlorierung Einiger Aliphatischer Äther. XIX. ***Leopold Horner and Horst Brüggemann.*** XX. ***Leopold Horner and Ludwig Schläfer.*** XXI. ***Leopold Horner, Bertram Anders, and Ottokar Basedow.*** *Annalen der Chemie (Justus Liebigs),* v. 635, nos. 1-3, Sept. 1960, p. 22-51.

CHEMISTRY—PHYSICAL

* **Estimation of the Concentration of Atomic Hydrogen and the Kinetic Chain Length in the Thermal Decomposition of Acetaldehyde.** The addition of labeled ethylene was used to determine the concentration of atomic H in the course of the cracking of acetaldehyde at 470 C and $P_0 = 300$ mm Hg. It has been shown that under these conditions the atomic H concentration changes from 2.10^8 atoms/cm^3 at the start of the

reaction to 2.10^6 atoms/cm^3 at 50% conversion. The kinetic chain length of acetaldehyde cracking is estimated. (*In Russian.*) Otsenka kontsentratsii atomarnogo vodoroda i dliny tsepi pri termicheskom razlozhenii atsetal'degida. ***V. D. Moiseev and M. B. Neiman.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 9, Sept. 1960, p. 1960-1966.

Cryoscopic Determination of the Purity of Lindane. A method is described which uses a simple freezing-point apparatus and a mercury-in-glass thermometer for the determination of the γ-benzene hexachloride content of samples of lindane. Collaborative results from four cooperative laboratories showed that the method gives reliable and reproducible results, in good agreement with those found by a differential refractometric method. A pure reference sample of γ-benzene hexachloride was prepared by zone-refining and values for its freezing point and cryoscopic constant measured by a platinum resistance thermometer. ***R. Handley.*** *Journal of Applied Chemistry,* v. 10, pt. 9, Sept. 1960, p. 353-357.

Recrystallization of Sodium Vinylbenzenesulfonate. With this method, purified monomer can be recovered in 80% yield from reaction mixtures containing sodium halide. ***Charles E. Grabiel, Leo R. Morris, Paul J. Sienknecht, and Rhodes N. Farris.*** *Industrial and Engineering Chemistry,* v. 52, Oct. 1960, p. 845-848.

The Kinetics of the Absorption of Phosgene Into Water and Aqueous Solutions. Pure phosgene gas was dissolved in short laminar jets of aqueous solution, and the results were interpreted with an unsteady state absorption-plus-reaction theory. Absorption rates of SO_2 and CO_2 into water in the same equipment support this interpretation. ***W. H. Manogue and R. L. Pigford.*** *A.I.Ch.E. Journal,* v. 6, no. 3, Sept. 1960, p. 494-500.

* **Determination of the Pressure of Vapor in Equilibrium With Solid Silicon Dioxide.** The over-all effusion rate of the components of vapor in equilibrium with solid SiO_2 at 1601-1739 K was determined by the integral variant of Knudsen's method, the amount of condensate in the receiver being determined colorimetrically. From the effusion rate data and the thermodynamic potentials, the heat of formation of gaseous SiO_2 at 0 K was calculated. (*In Russian.*) Opredelenie davleniia para, ravnovesnogo s tverdoĭ dvuokisiu kremniia. ***An. N. Nesmeianov and L. P. Firsova.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 9, Sept. 1960, p. 1907-1910.

* **Investigations of the Vapor Pressure and Density of Systems Containing Organosilicon Compounds. II. Systems: Methyldichlorosilane-methyltrichlorosilane-methylphenyldichlorosilane and Methylphenyldichlorosilane-methylchlorophenyldichlorosilane-methyldichlorophenyldichlorosilane.** The constants of the Antoine equations and the values of the heats and entropies of vaporization of the individual liquids and solutions at the normal boiling points are calculated. (*In Russian.*) Issledovanie davleniia i plotnosti para v sistemakh, soderzhashchich kremniĭorganicheskie soedineniia. II. Sistemy metildikhlorsilan-metiltrikhlorsilan-metilfenildikhlorsilan i metilfendikhlorsilan-metilklorfonildikhlorsilan-metildikhlorfenildikhlorsilan. ***E. A. Balamutova, et al.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 9, Sept. 1960, p. 1916-1919.

* **Polarographic Studies of Organic Oxidation-Reduction Systems. The System Altex-Captax.** Anodic and cathodic waves were obtained. The good agreement between the slow discharge-ionization theory and the experimental results indicates that the Captax molecules are associated in pairs by H bonds. A new method is proposed for measuring the redox potential of strongly irreversible organic oxidation-reduction systems. The exchange current in the system was calculated. (*In Russian.*) Poliarograficheskoe izuchenie organicheskikh okislitel'no-vosstanovitel'nykh sistem. Sistema Al'taks–Kaptaks. ***A. G. Stromberg and V. D. Bogoslovskiĭ.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 9, Sept. 1960, p. 1947-1951.

* **Application of the Kinetic Tracer Method for Studying the Oxidation of Methane in the Presence of Nitromethane.** In the oxidation of methane catalyzed by the addition of nitromethane, the latter is not only decomposed, but also regenerated as a result of interaction of methane with nitrogen oxides. The formation and consumption rates of nitromethane

are computed. Nitromethane is shown to exchange methyl groups with a methane molecule. (*In Russian.*) Primenenie kineticheskogo izotopnogo metoda dlia issledovaniia okisleniia metana v prisutstvii nitrometana. ***V. B. Miller, et al.*** *Zhurnal Fizicheskoĭ Khimii,* v. 34, no. 9, Sept. 1960, p. 1980-1986.

* **Gas Formation Mechanism in Radiolysis of Organic Compounds and Its Relation to Their Aggregate State.** The effects of the change of temperature on the formation of gaseous radiolysis products of the substances investigated during their exposure to light in the solid or liquid state is very low, according to the low values of the energy of activation of such reactions, and have practically the same coefficient of temperature, although in the region of transition at melting temperature, the process of gas formation suddenly changes. (*In Russian.*) Mekhanizm gazoobrazovaniia pri radiolize organicheskikh veshchestv i sviaz' ego s ikh agregatnym sostoianiem. ***A. B. Taueman, L. P. Ianova, R. S. Maslovskaia, and P. Ia. Glazunov.*** *Akademiia Nauk SSSR, Doklady,* v. 134, no. 2, Sept. 1960, p. 397-399.

Method for Investigating the Order of Chemiluminescent Reactions, the Diffusion Coefficient of the Labile Reactants, and the Catalytic Efficiency of Surfaces. A method is proposed for investigating the order of chemiluminescent reactions, the diffusion coefficient, and the catalytic efficiencies of surfaces for gas-phase labile species. This method utilized the change in the decay rate of the labile reactants and of the light intensity. The decay rate of the labile species is controlled through adjustment of their diffusion loss to a catalytic surface. ***Robert A. Young.*** *Journal of Chemical Physics,* v. 33, Oct. 1960, p. 1044-1046.

Metal-Metal Bonding in Dicobalt Hexacarbonyl Diphenylacetylene. Nature of the bonding is discussed in terms of simple molecular-orbital theory. ***David A. Brown.*** *Journal of Chemical Physics,* v. 33, Oct. 1960, p. 1037-1043.

Photolysis of Carbon Dioxide. The vacuum ultraviolet photolysis of carbon dioxide has been investigated. Kinetic data and quantum yield measurements indicate that electronically excited (^1D) oxygen atoms are produced in the the primary process at 1470 A and 1236 A. Such a primary process is consistent with the tentative spectral assignments which have been made for carbon dioxide. ***Bruce H. Mahan.*** *Journal of Chemical Physics,* v. 33, Oct. 1960, p. 959-965.

* **Polarographic Study of Iodomethyltrialkylsilanes. An Unusual Polarographic Maximum on the Iodomethylphenyldimethylsilane Wave.** (*In Russian.*) Poliarograficheskoe izuchenie iodmetiltrialkilsilanov. Neobychnyĭ poliarograficheskiĭ maksimum na volne ĭodmetilfenildimetsilana. ***S. G. Maĭranovskii, V. A. Ponomarenko, N. V. Barashkova, and A. D. Snegova.*** *Akademiia Nauk SSSR, Doklady,* v. 134, no. 2, Sept. 1960, p. 387-390.

Determination of the Value of the Faraday With a Silver-Perchloric Acid Coulometer. An accurate value was determined by the electrolytic dissolution of metallic silver. The electric current was measured in terms of the standards of electromotive force and electrical resistance. ***D. Norman Craig, James I. Hoffman, Catherine A. Law, and Walter J. Hamer.*** *U. S. National Bureau of Standards, Journal of Research, Section A, Physics and Chemistry,* v. 64A, no. 5, Sept.-Oct. 1960, p. 381-402.

Transient Benzyl Radical Reactions Produced by High-Energy Radiation. Lifetime measurements in solution at 25 C were made on the benzyl radical produced by a pulsed beam of electrons from a linear accelerator. The absorption spectrum of the radical was measured both photographically and photoelectrically as a function of time and solvent. ***R. L. McCarthy and A. MacLachlan.*** *Faraday Society, Transactions,* v. 56, Aug. 1960, p. 1187-1200 + 2 plates.

Heats of Immersion. IV. The Alumina-Water System—Variations With Particle Size and Outgassing Temperature. Samples of α-, γ- and amorphous-alumina with surface areas from 0.222 to 221 m.^{2}/g. were studied following vacuum outgassing treatments over the temperature range, 100-450°. In addition, weight loss measurements were made as a function of temperature. Usually a substantial increase was noted for the

heats of immersion with decreasing specific area and increasing outgassing temperature. ***W. H. Wade and Norman Hackerman.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1196-1199.

*** Absolute Rate Measurements of O-Atom Reactions With Ethylene and With Butane.** Measurement of the absolute rate constant and its temperature dependence for the reaction of O-atoms with ethylene. For comparison purposes, similar measurements were also obtained for the reaction of O-atoms with *n*-butane. ***L. Elias and H. I. Schiff.*** *Canadian Journal of Chemistry*, v. 38, Oct. 1960, p. 1657-1665.

The Flash Photolysis of Halate and Other Ions in Solution. The photochemistry of aqueous bromate solutions was examined by the technique of flash photolysis. Two transients were observed and tentatively identified; a short-lived transient (~10 μsec) absorbing at 350-390 mμ was assigned to BrO_3· radical (disappearance probably first order), and a longer lived transient (~1 msec) absorbing at 460 mμ to BrO· radical (disappearance second order). ***N. K. Bridge and M. S. Matheson.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1280-1285.

A New Procedure for Calculating the Four Diffusion Coefficients of Three-Component Systems From Gouy Diffusiometer Data. ***Hiroshi Fujita and Louis J. Gosting.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1256-1263.

The Reaction of Hydrogen Atoms With Solid Propene at Low Temperatures. The H atoms diffuse through and react with the propene films to form propane and 2,3-dimethylbutane. A one dimensional diffusion equation containing a chemical reaction is used to describe the kinetics of this process. ***Ralph Klein, Milton D. Scheer, and John G. Waller.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1247-1250.

Equilibrium Constants for the Formation of Polynuclear Tridentate 1:1 Chelates in Uranyl-Malate, -Citrate and -Tartrate Systems. *p*H Titrations were analyzed to determine the over-all dimerization constants K_{III} and the trimerization constants $K_{T'}$ for the tridentate 1:1 chelates in the uranyl-malate, -citrate and -*d*-tartrate systems at 25°. ***Isaac Feldman, Carol A. North, and Hugh B. Hunter.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1224-1230.

The Sorption of Gaseous Hydrogen Chloride by Dry Lyophilized β-Lactoglobulin. The sorption of gaseous HCl by dry lyophilized β-lactoglobulin was studied at 27°. HCl is held so firmly on some of the sorption sites that it cannot be removed by pumping to a high vacuum. Results show that the amount remaining sorbed on the protein is some reciprocal function of the temperature. ***Wasyl S. Hnojewyj and Lloyd H. Reyerson.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1199-1202.

Detection of Metal Ion Hydrolysis by Coagulation. II. Thorium. Coagulation and stabilization concentrations for aqueous thorium nitrate solutions were obtained as a function of *p*H using silver iodide, silver bromide and silver chloride sols *in statu nascendi*. ***E. Matijević, M. B. Abramson, K. F. Schulz, and M. Kerker.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1157-1161.

Adsorption Studies on Metals. IX. The Nature of the Thermal Regeneration of Oxide-Coated Nickel, Cobalt and Copper. Organic vapors were used as a probe for any bare metal surface uncovered during regeneration. The heats of adsorption of *n*-propylamine and acetic acid on the bare, oxide-coated and regenerated metal surfaces support the contention of Dell that recrystallization occurs. Initial heats of adsorption were much higher on the regenerated surfaces, in accord with the values for the freshly reduced metals, and were much lower on the oxide-coated surfaces. The extents of irreversible adsorption followed the pattern to be expected from the heat measurements. ***A. C. Zettlemoyer, Yung-Fang Yu, and J. J. Chessick.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1099-1102.

The Chemisorption of Oxygen on Nickel. The chemisorption of O on nickel-silica catalyst systems was investigated by the low frequency a.c. permeameter method and volumetric gas adsorption techniques. The Ni particles were in the superparamagnetic range or slightly larger. A method was developed for distinguishing between true chemisorption of O on Ni as

contrasted with surface oxide formation. The method makes use of what appears to be a change of magnetic anisotropy energy in particles of Ni in the 100 Å diameter range. Discusses a possible explanation for the so-called "hydride anomaly" in the chemisorption of H on Ni at low temperatures. ***Robert J. Leak and P. W. Selwood.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1114-1120.

A Prediction of Heterogeneous Catalytic Reactions. Catalytic oxidation of hydrogen-deuterium mixtures. With copper oxide as the catalyst H_2O would be formed at a faster rate than D_2O while with nickel oxide as a catalyst, the two reactions were predicted to occur at the same rate. ***R. A. Gardner.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1120-1123.

Studies of Silicate Minerals. VI. Acid Sites on Kaolin and Silica-Alumina Cracking Catalysts. The determination of the strength of acid sites on a variety of synthetic silica-alumina and kaolin-based cracking catalysts was carried out. Samples first activated at 400 C under vacuum were exposed to saturated *n*-butylamine vapor at 25 C. The total amount chemisorbed and amounts desorbed at incremental temperatures between 25 and 400 C under vacuum were not determined. More quantitatively, desorption data can be combined with heats of immersional wetting measured as a function of surface concentration to furnish differential heat and site energy distribution curves. In addition, the number of sites for amine adsorption which developed as activation temperature increased was followed. Adsorption of amines of varying size was utilized to provide information concerning the spatial distribution of acid sites. ***A. C. Zettlemoyer and J. J. Chessick.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1131-1134.

Surface Chemistry From Spectral Analysis of Totally Internally Reflected Radiation. Phenomenon of total internal reflection with the possibility in mind of applying it to the study of the spectra of surfaces of optically transparent materials, particularly semiconductors. ***N. J. Harrick.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1110-1114.

The Chemisorption of Hydrogen on Nickel. The pressure of H in equilibrium with H adsorbed on Ni films produced by evaporation was measured by means of an ionization gage. Calculates from the results the molar and differential entropies of the adsorbed H at 25 C and the integral and isosteric heats of adsorption. The molar entropy in the range $\theta = 0$ to 0.4, agreed satisfactorily with the view that the adsorbed H was localized on sites which were energetically homogeneous. However, the entropy and the heat of adsorption indicated that there were sites of higher adsorption potential which amounted to about 1.5% of the surface. ***Eric Rideal and F. Sweett.*** *Royal Society, Proceedings*, v. 257, ser. A, Sept. 20, 1960, p. 291-301.

Ultrasonic Relaxation in Triethylamine. The absorption of ultrasonic waves in triethylamine was studied at temperatures between −50 and 25 C, at frequencies between 10 and 100 Mc/s. ***R. A. Padmanabhan and E. L. Heasell.*** *Physical Society, Proceedings*, v. 76, pt. 3, Sept. 1960, p. 321-328.

Rotational Analysis of the 5-1 Band of the B′B System of N_2. The 5-1 band of the recently discovered B′→B system of N_2 was photographed under large dispersion and a rotational analysis was made. The upper state was shown to be of species $^3\Sigma_u^-$ and the lower state was confirmed to be $B^3\Pi g$. The spin structure of the $^3\Sigma_u^-$ state was determined and a discrepancy between theory and experiment noted. ***P. K. Carroll and H. E. Rubalcava.*** *Physical Society, Proceedings*, v. 76, pt. 3, Sept. 1960, p. 337-345.

*** Spin-Spin Coupling Constants in Some Three-Membered Heterocycles.** An analysis of the C^{13} satellite resonances in the nmr spectra of ethylene oxide, ethylene imine, and ethyelne sulfide are reported. Two of the three interproton coupling constants, as well as the C^{13}–H couplings, can be accurately determined for each compound. An estimate of the H–C–H coupling for ethylene imine has also been obtained. There are remarkably large variations in the size of the couplings as a result of changing the hetero-atom, even though the geometrical structures of the three molecules are very similar. ***Forrest S. Mortimer.*** *Journal of Molecular Spectroscopy*, v. 5, no. 3, Sept. 1960, p. 199-205.

* **Spectral Characteristics of Several Series of More Unusual Aromatic Hydrocarbons.** Energy and intensity data are presented for π-electronic transitions in several families of more unusual aromatic hydrocarbons. Emphasis is placed on certain special classes of benzene and naphthalene compounds, systems of nuclei connected by polyene chains, and compounds containing five- and seven-membered rings. ***E. Miller Layton, Jr.*** *Journal of Molecular Spectroscopy*, v. 5, no. 3, Sept. 1960, p. 181-198.

* **The Pyrolysis of Alkyl Hydroperoxides in the Gas Phase.** Ethyl, isopropyl and t-butyl hydroperoxides were pyrolyzed in benzene as carrier between 280 and 380 C and the rate constants for the homogeneous decomposition obtained from measurement of the diphenyl produced. ***Alexander D. Kirk and John H. Knox.*** *Faraday Society, Transactions*, v. 56, Sept. 1960, p. 1296-1303.

* **The Pyrolysis of Mercury Dimethyl. III. The Effect of Added Nitrogen, Ethane and Azomethane.** The mechanism of thermal decomposition of mercury dimethyl vapor was investigated further by studying the effects of nitrogen, ethane, and methyl radicals from azomethane on rate constant and products of decomposition in a static system at temperatures within the range 303-332 C. Hot radicals are liberated by the azomethane, but if these are quenched the evidence from all three lines of enquiry is consistent with earlier studies and indicates that ordinary thermal methyl radicals do not to any significant extent participate in the reaction under the conditions of the experiments. ***J. Cattanach and L. H. Long.*** *Faraday Society, Transactions*, v. 56, Sept. 1960, p. 1286-1295.

* **Hydration Equilibria of Some Aldehydes and Ketones.** Measurements of ultra-violet absorption were used to determine the degree of dissociation over a range of temperatures of the hydrates of monochloroacetones, s-dichloroacetone, as-dichloroacetone and diacetyl in water, of s-dichloroacetone in dioxan+water mixtures, and of chloral in cyclohexane. Heats and entropies of dissociation are calculated, and the results for these and other compounds related to other thermodynamic data and to structural features. ***R. P. Bell and A. O. McDougall.*** *Faraday Society, Transactions*, v. 56, Sept. 1960, p. 1281-1285.

* **The Significance of Benzenoid Rings for the Stability of Aromatic Hydrocarbons.** The hitherto unknown tribenzotetracene was synthesized and fitted into the series: heptacene, benzohexacene, the dibenzopentacenes, tribenzotetracene, and tetrabenzanthracene. It is obvious that in the series the stability increases and the absorption bands shift to shorter wavelength with the number of benzenoid rings. ***E. Clar and A. McCallum.*** *Tetrahedron*, v. 10, nos. 3-4, Aug. 1960, p. 171-174.

* **The In-Plane Normal Coordinate Analysis of a Model *para*-Disubstituted Benzene Derivative.** In connection with a problem in electronic spectroscopy, an in-plane normal coordinate analysis for a model *para*-disubstituted benzene was carried out using an IBM650 computer. The substituent, *X*, has a mass of 20 and the *C–X* distance is 1.40 A. All other parameters including the force field are taken from benzene. Frequencies, potential energy distributions, and the normal coordinates are given. Comparison is made with assignments reported for symmetrical *p*-dihalogenobenzenes and good agreement is found. The calculated frequencies show a rather striking agreement with those observed in *p*-difluorobenzene. ***Andreas C. Albrecht.*** *Journal of Molecular Spectroscopy*, v. 5, no. 3, Sept. 1960, p. 256-263.

* **Vibrational Spectra and Normal Coordinate Treatment of Cyclobutanone and $\alpha, \alpha, \alpha', \alpha'$-$d_4$-Cyclobutanone.** With a double-pass prism instrument, the infrared spectra of cyclobutanone and $\alpha, \alpha, \alpha', \alpha'$-$d_4$-cyclobutanone were studied from 7000 cm^{-1} to 300 cm^{-1} in the gaseous and liquid phases. The Raman spectra of the two liquid isotopic species were photographed with a three-prism spectrograph. A normal coordinate treatment was carried out using the Wilson FG-method. The force constants of the ring vibrations were varied to demonstrate their coupling with the methylene and carbonyl vibrations. A satisfactory assignment is suggested for all of the 27 fundamentals but the lowest lying mode υ_{27} (b_2) due to the out-of-plane ring deformation. ***K. Frei and Hs. H. Günthard.*** *Journal of Molecular Spectroscopy*, v. 5, no. 3, Sept. 1960, p. 218-235.

a * **Potential Energy Constants, Rotational Distortion Constants, and Calculated Thermodynamic Properties for Methyl Cyanide and Methyl Isocyanide.** ***M. G. Krishna Pillai and Forrest F. Cleveland.*** *Journal of Molecular Spectroscopy*, v. 5, no. 3, Sept. 1960, p. 212-217.

b * **Polarographie Determination of Germanium as Benzcathechingermanium Acid.** In acid solution (pH4.0), this acid gives at the Hg dropping electrode a characteristic curve near -0.65V (as compared with the saturated calomel electrode). The height of this curve is proportional to the Ge concentration. This method is very suitable for the qualitative and quantitative determination of Ge after its separation by extraction and distillation. (*In German.*) Die polarographische Bestimmung von Germanium als Brenzcatechingermaniumsäure. ***Nelly Konopik.*** *Monatshefte für Chemie*, v. 91, no. 4, Sept. 12, 1960, p. 717-728.

c * **A Contribution to the Study of Some Physico-Chemical Properties of Tellurium Trioxide.** The solubility of tellurium trioxide was checked in water and in solutions of caustic Na and of soda. The value of this solubility was determined as a function of the temperature and concentration of the solutions. By chemical, petrographical and radiostructural analyses, the composition of equiponderant solid phases obtained during the reaction of TeO_3 with the above solutions was examined. At the same temperature, depending on the amount of soda or caustic Na in the solution, Na tellurates of different composition are formed. (*In Russian.*) K izucheniiu nekotorykh fiziko-khimicheskikh svoĭstv trekhokisi tellura. ***M. S. Sarsembaev and V. D. Ponomarev.*** *Akademiia Nauk Kazakhskoĭ SSR, Vestnik*, v. 16, no. 8 (185), Aug. 1960, p. 69-78.

d **Annual Review of Physical Chemistry.** New feature of this volume is a comprehensive index of this and all previous volumes. The chapter on fused salts is an indication of the current emphasis on high-temperature chemistry, as is also the chapter on combustion and flames. The reviews generally deal critically with significant aspects of important fields rather than attempt an exhaustive uncritical listing of references. ***H. Eyring, C. J. Christensen, and H. S. Johnston, editors.*** v. XI. 588 pp. 1960. Annual Reviews, Inc., Palo Alto, Calif. (QD453 R64a Vis.)

COATINGS

e **New Contenders Groom for Plastics Jobs.** Discusses new generations of now-commercial polymers, polyspiroacetals, transpolyolefins, and polyoxetanes. *Chemical Week*, v. 87, no. 16, Oct. 15, 1960, p. 105 + 3 pages.

f * **Modern Applications in Chromate Coatings.** ***Kenneth P. Bellinger.*** *Metal Finishing Journal*, v. 6, no. 69, Sept. 1960, p. 365-367.

g **Oxidation of Evaporated Magnesium Films.** The oxidation at low pressures and temperatures of evaporated Mg films was studied by the Wagener flow method. In the initial period of oxidation, the sticking probability usually increased with the uptake of O, suggesting a nucleation effect. In the second period of the oxidation the sticking probability fell rapidly. The oxidized Mg surfaces were studied by electron diffraction and electron microscopy. ***M. S. Cohen.*** *Acta Metallurgica*, v. 8, June 1960, p. 356-361.

h * **Determine Printability of Polyethylene With Fast, Accurate Test.** A new procedure, known as the inclining platform test, promises swift and accurate testing not found in previous methods. ***T. F. McLaughlin, Jr.*** *Paper, Film and Foil Converter*, v. 34, Oct. 1960, p. 61-62.

i **Industrial Finishing Year Book, 1960.** Annual reference book covering the finishing trades. 296 pp. 1960. Arrow Press Ltd., London. (TP934 In2)

j * **Duration Tests on Rust Inhibiting Paints.** Rust inhibiting properties of paints made of raw materials which came into general use in the mid-1940's were studied by means of outdoor tests on steel panels. (*In Swedish.*) Långtidsprovning av rostskyddande färger. ***Börje Andersson.*** *TVF. Teknisk-Vetenskaplig Forskning*, v. 31, no. 5, 1960, p. 196-209.

k

New Ceramic-Coated Metal Takes Over Where Glassed Steel Leaves Off. *Chemical Engineering*, v. 67, Oct. 3, 1960, p. 130 + 2 pages.

* **Developments Within the Tall Oil Industry.** ***W. Krohnstad.*** *Svensk Kemisk Tidskrift*, v. 72, no. 8, 1960, p. 509-515.

* **Polymeric Emulsions for Functional Paper Coatings. II.** Packaging with plastic-coated paper; barrier properties of packaging material; taste, odor and optical properties. ***Anton Jurecic.*** *Southern Pulp and Paper Manufacturer*, v. 23, Oct. 10, 1960, p. 28-30.

* **Water Dispersed Coatings for Metals.** Latex, liquid resin, and water soluble primers are being tested on automobiles and other metal products and considerable progress is being made in overcoming difficulties of each system. Each of these systems is discussed. ***E. R. Meincke.*** *Paint Industry Magazine*, v. 75, Oct. 1960, p. 9-11.

* **The Performance and Composition of Corrosion Inhibitive Paints for Structural Steel.** ***E. K. Zimmermann.*** *Paint Industry Magazine*, v. 75, Oct. 1960, p. 18 + 3 pages.

* **A Method of Improving Ink Transfer in the Roll Mill Nip.** ***James H. Taylor, Jr. and A. C. Zettlemoyer.*** *Paint Industry Magazine*, v. 75, Oct. 1960, p. 34 + 3 pages.

* **Fluorocarbon Polymers Meet Corrosion Challenge.** Fluorinated plastics, elastomers, oils, greases, and waves provide unique thermal, mechanical, and corrosion-resistant properties. ***Robert P. Bringer and Cedric C. Sovia.*** *Chemical Engineering Progress*, v. 56, Oct. 1960, p. 37-42.

* **Preparation of Dehydrated Castor Oil.** A kaolin-sulfuric acid catalyst containing about 1% of sulfuric acid was most effective. The product had a very strong drying property forming a transparent and lustrous film. (*In Japanese.*) ***Osamu Okubo.*** *Government Chemical Industrial Research Institute, Tokyo, Reports*, v. 55, Aug. 1960, p. 315-318.

* **Synthesis of Polyoxyethylene Derivatives of Diesters of Sucrose With Long-Chain Fatty Acids.** ***Saburo Komori, Mitsuo Okahara, and Kenzo Okamoto.*** *American Oil Chemists' Society, Journal*, v. 37, Oct. 1960, p. 468-473.

* **A Kinetic Study of the Autoxidation of Methyl Linoleate and Linoleic Acid Emulsions in the Presence of Sodium Chloride.** ***Ahmed Fahmy Mabrouk and L. R. Dugan, Jr.*** *American Oil Chemists' Society, Journal*, v. 37, Oct. 1960, p. 486-490.

Study of Air Permeability of Concrete Paints and Sealants for Reactor Housing Installations. ***L. Baurmash, R. H. Seefred, and C. T. Nelson.*** *U. S. Atomic Energy Commission, NAA-SR-5411*, Sept. 15, 1960, 20 pp. (UF767 Un3.1na Contin.)

Corrosion Concepts for Glassed Steel. A survey of the extent of corrosion resistance of glassed steel, defining more exactly the areas of its usefulness, and exploring some of the more interesting aspects of its reaction to chemical attack. ***D. K. Priest.*** *American Ceramic Society Bulletin*, v. 39, Oct. 1960, p. 507-510.

The Polyester Finish. Discusses the two basic types of polyester finishes, their merits and limitations. ***P. C. Bardin.*** *Industrial Finishing*, v. 36, no. 12, Oct. 1960, p. 50 + 3 pages.

The Use of Fillers in Wood Finishing. What's in wood fillers, why they weigh so heavy; solvents for wood fillers; how to judge the mix. ***George A. Conrad.*** *Industrial Finishing*, v. 36, no. 12, Oct. 1960, p. 66 + 5 pages.

* **Gelation and Formulation Theory of Ester Resin. I. Predication of Gelation. II. Various Functionalities.** ***Christian W. Johnston.*** *Official Digest*, v. 32, Oct. 1960, p. 1327-1346.

* **Zinc Pigments in Exterior House Paints.** Papers of a symposium presented by a panel to encourage the use of zinc pigments. ***D. W. Pettigrew, moderator.*** *Official Digest*, v. 32, Oct. 1960, p. 1289-1312.

* **Proceedings of the Paint Research Institute. X. Lithium Soap Recipes for Particle Size Control in Emulsion Copolymerization of Styrene and Butadiene.** ***Tito T. Serafini and Edward G. Bobalek.*** *Official Digest*, v. 32, Oct. 1960, p. 1259-1288.

a * **The Dispersion of Pigments in Highly Viscous Media.** Fine grinding of pigments on jet mills; methods of dispersion of pigments in binders; processing of highly viscous colored pastes; influence of dispersing admixtures; composition of dry milled pastes. ***I. M. Alekseev.*** *Official Digest*, v. 32, Oct. 1960, p. 1313-1324.

b **Magnetic Properties of Epitaxially Grown Films.** The possible advantages of using epitaxially grown films in studies of thin film properties are discussed, with particular reference to magnetic properties. Methods suitable for magnetic measurements are described and a summary of the types of result obtained to date is given. Preliminary results are given for measurements of the Faraday rotation in epitaxially grown nickel films. ***O. S. Heavens.*** *Research Applied in Industry*, v. 13, Oct. 1960, c p. 404-410.

CONTROL SYSTEMS, COMPUTERS, AND SYSTEMS ENGINEERING

d * **Some Philosophical Problems of Cybernetics.** A critical examination of the definition and concepts of cybernetics from the Soviet materialistic point of view. (*In German.*) Einige philosophische Fragen der Kybernetik. ***S. Anissimow and A. Wislobokow.*** *Technik*, v. 15, Sept. 1960, p. 577-584.

e * **Loss and Recovery of Information by Coarse Observation of Stochastic Chain.** In a stationary stochastic chain, the states are grouped into classes or coarsely defined macrostates, engendering another chain defined in terms of macrostates. Loss of information caused by the coarseness of the definition of macrostates can be recovered, partially or totally depending on the case, when there is correlation in the chain. ***Satosi Watanabe and Chacko T. Abraham.*** *Information and Control*, v. 3, no. 3, Sept. 1960, p. 248-278.

f **Analogue and Digital Computers.** Discusses introduction to computers, operation and application of analogue computers, design of analogue-computing systems, analogue-computing circuits, number representation in digital computers, operation of a digital computer, circuit elements of computer units, storage, and input-output equipment. ***M. G. Say, A. C. D. Haley, and W. E. Scott, editors.*** 308 pp. 1960. Philosophical Library, g New York. (QA76 H13a)

* **Static Switching.** The purposes and advantages of static switching and its derivation from digital computer techniques are outlined. A comparison of existing techniques is made and a complete system employing NOR units as the logic element is described, together with the treatment and solution of a simple problem. ***G. T. Ohlsen.*** *Electronic Engineering*, v. 32, Oct. h 1960, p. 609-613.

* **An Explanation of ALGOL 60.** Programming is introduced and analyzed in the first section. The operation of compilers is then taken up. The majority of this work is devoted to an explanation of the problem language, ALGOL 60, which is discussed in a tutorially convenient sequence in the next section. An example of coding in ALGOL 60 follows. The paper concludes with indications of the need filled by ALGOL and the areas which require further attention. ***Ivan Flores.*** *Datamation*, v. 6, no. 5, Sept.-Oct. 1960, p. 46-50.

Data Acquisition Link Makes or Breaks Checkout Designs. Limit on the number of checks is discussed. It is pointed out that frequency data are unaffected by noise, that cable specs have been strengthened, that grounding can lick noise problem. ***Bernard Kovit.*** *Space/Aeronautics*, v. 34, no. 4, Oct. 1960, p. 215-219.

* **Predicting Controller Settings. A Computer Approach to Optimum Process Control.** Using a digital computer, techniques are developed for analyzing processes involving time delays, which indicate optimum controller settings. ***L. R. Freeman and R. L. Owen.*** *ISA Journal*, v. 7, Oct. 1960, p. 52-57.

k **Multiplier for Analog Computers.** This multiplier uses an operational amplifier in a new circuit configuration. One input variable controls the amplitude of the multiplier's output pulses

and the other variable controls their duration. The amplitude-time product of these pulses corresponds to product of the input variables. ***A. J. Ferraro.*** *Electronics*, v. 33, no. 45, Nov. 4, 1960, p. 73-74.

Precision Servo Regulator Controls High-Power Magnetic Field. Double-loop servo system holds the field of large electromagnet constant to one part in fifteen million. ***A. M. Patlach.*** *Electronics*, v. 33, no. 45, Nov. 4, 1960, p. 66-69.

Dynamic Programming Approach to a Final-Value Control System With a Random Variable Having an Unknown Distribution Function. The state vector x_n, representing the present state of a sampling control system, is assumed to satisfy a difference equation $x_{n+1} = T(x_n, r_n, v_n)$, where v_n is the control vector of the system subject to random disturbances r_n. The random variables r_n are assumed to be independent of each other and to be defined in a parameter space in the following manner: Nature is assumed to be in one of a finite number, q, of possible states, and each state has its own parameter value. Formulas and solutions of equations are discussed. ***Masanao Aoki.*** *IRE Transactions on Automatic Control*, v. AC-5, no. 4, Sept. 1960, p. 270-283.

Mathematical Aspects of the Synthesis of Linear Minimum Response-Time Controllers. The results are limited to the case where the process to be controlled has dynamics which are completely known and are adequately described by a system of linear differential equations. The implication of the method presented is that any process as limited above can be time-optimally controlled, in those cases where a time-optimal controller exists, provided an underlying system of transcendental equations can be solved. ***E. Bruce Lee.*** *IRE Transactions on Automatic Control*, v. AC-5, no. 4, Sept. 1960, p. 283-290. (TK1 In6.6ac Vis.)

Statistical Design of Digital Control Systems. The minimum mean-square error is adopted as the performance criterion; and the system design is based upon the Wiener-Kolmogoroff theory of optimum filtering and prediction. The treatment of this optimization problem makes use of the modified z-transform technique, and is presented in close parallel with the procedure for the statistical design of linear continuous-data control systems. ***Julius T. Tou.*** *IRE Transactions on Automatic Control*, v. AC-5, no. 4, Sept. 1960, p. 290-297. (TK1 In6.6ac Vis.)

Determination of Periodic Modes in Relay Servomechanisms Employing Sampled Data. In using the method, together with Izawa and Weaver's method, the investigator can have all the information concerning possible periodic modes of a system. This new technique is based on expressing periodic sequences in terms of orthogonal functions in the discrete sense and balancing the harmonics. ***H. C. Torng and W. E. Meserve.*** *IRE Transactions on Automatic Control*, v. AC-5, no. 4, Sept. 1960, p. 298-305. (TK1 In6.6ac Vis.)

Analysis of Pulse Duration Sampled-Data Systems With Linear Elements. The characteristics of pulse duration sampled data are first briefly described. An analytical means for studying the transient response and stability of systems which use this kind of data is then presented. ***R. E. Andeen.*** *IRE Transactions on Automatic Control*, v. AC-5, no. 4, Sept. 1960, p. 306-313. (TK1 In6.6ac Vis.)

The Analysis of Cross-Coupling Effects on the Stability of Two-Dimensional, Orthogonal, Feedback Control Systems. The stability of the two-dimensional, cross-coupled, feedback control system is studied by complex-plane methods, and a method is developed for determining whether a system is stable or not. A technique is also indicated to show how an unstable system may be made stable by the introduction of appropriate cross-coupling. ***David Bruce Newman.*** *IRE Transactions on Automatic Control*, v. AC-5, no. 4, Sept. 1960, p. 314-320. (TK1 In6.6ac Vis.)

Stabilization of Linear Multivariable Feedback Control Systems. A method of system stabilization is discussed, which reduces the problem to essentially that of a single variable system. This method uses a compensating matrix which is either the inverse system- or transposed system-matrix. ***E. V. Bohn.*** *IRE Transactions on Automatic Control*, v. AC-5, no. 4, Sept. 1960, p. 321-327. (TK1 In6.6ac Vis.)

Stability of Systems With Randomly Time-Varying Parameters. The stability of a system which alternates between stable and unstable configurations at random times may be investigated, conveniently using Kronecker products. The system is stable with probability, if, and only if, all the eigenvalues of a specified matrix lie within the unit circle. ***A. R. Bergen.*** *IRE Transactions on Automatic Control*, v. AC-5, no. 4, Sept. 1960, p. 265-269. (TK1 In6.6ac Vis.)

Transistor Current Switching and Routing Techniques. A system of circuit logic is described in which transistors, particularly diffused base transistors, are operated well out of saturation in order to make the most of their speed. Logical information is contained in the presence or absence of a current which can be switched or routed by the gates described. ***D. B. Jarvis, L. P. Morgan, and J. A. Weaver.*** *IRE Transactions on Electronic Computers*, v. EC-9, no. 3, Sept. 1960, p. 302-308. (TK1 In6.6e Vis.)

Magnetic Film Memories, A Survey. An analysis is made of the modes of magnetization reversal and rotation in thin ferromagnetic films. The ways in which the various modes can be employed for destructive and nondestructive memories are discussed and their performance limitations considered. ***A. V. Pohm and E. N. Mitchell.*** *IRE Transactions on Electronic Computers*, v. EC-9, no. 3, Sept. 1960, p. 308-314. (TK1 In6.6e Vis.)

Some Applications of Magnetic Film Parametrons as Logical Devices. High-frequency magnetic film parametrons have been made and observed to exhibit two- or three-state operation for a single bias condition. As a two-stable-state device, the magnetic film parametron can be used as a majority decision element in much the same way as the ferrite core parametron. Proposed logical designs for a two-element binary adder, a binary shift counter, and a shift register are presented. ***R. F. Schauer, R. M. Stewart, Jr., A. V. Pohm, and A. A. Read.*** *IRE Transactions on Electronic Computers*, v. EC-9, no. 3, Sept. 1960, p. 315-320. (TK1 In6.6e Vis.)

DC Amplifier Misalignment in Computing Systems. This paper will generalize the concept of the equivalent input circuit representation for dc offset for the four amplifier types with finite input impedances, and will give the conditions under which the use of each equivalent circuit is justified. In each case, two offset generators which are characteristic of the amplifier alone—independent of driving source impedance and load impedance termination—are defined. ***R. L. Konigsberg.*** *IRE Transactions on Electronic Computers*, v. EC-9, no. 3, Sept. 1960, p. 352-358. (TK1 In6.6e Vis.)

The Use of Parenthesis-Free Notation for the Automatic Design of Switching Circuits. The notation facilitates the calculation of circuit parameters and permits an unambiguous characterization of the circuit topology. It is shown how an infeasible series-parallel network can be transformed into an equivalent feasible network by "cascading" operations applied to the two-terminal sub-networks of the original network. A systematic method is developed, resulting in an optimum choice of cascading operations. ***E. L. Lawler and G. A. Salton.*** *IRE Transactions on Electronic Computers*, v. EC-9, no. 3, Sept. 1960, p. 342-352. (TK1 In6.6e Vis.)

A Theorem for Deriving Majority-Logic Networks Within an Augmented Boolean Algebra. Recent developments in computer technology have produced devices (parametrons, Esaki diodes) that act logically as binary majority-decision elements. Conventional design techniques fail to utilize fully the logical properties of these devices. The resulting designs are extravagant. This paper reviews the conventional technique briefly and proposes an alternative method that produces more nearly minimal designs. ***R. Lindaman.*** *IRE Transactions on Electronic Computers*, v. EC-9, no. 3, Sept. 1960, p. 338-342. (TK1 In6.6e Vis.)

Error Detecting and Correcting Binary Codes for Arithmetic Operations. The most important property of the codes derived in this paper is that two numbers, i and j, have coded forms, $C(i)$ and $C(j)$ that when added in a conventional binary adder, give a sum $C(i) + C(j)$ that differs from $C(i + j)$, the code for the sum, by (at most) an additive constant. This makes possible the detection and/or correction of errors committed by the arithmetic element of a computer. ***David T.***

Brown. *IRE Transactions on Electronic Computers,* v. EC-9, no. 3, Sept. 1960, p. 333-337. (TK1 In6.6e Vis.)

Magnetostrictive Ultrasonic Delay Lines for a PCM Communication System. A servo-operated delay-line pad and a temperature-compensated delay-line memory, both magnetostrictively driven at 1.5 mc, have been used in an experimental PCM communication system. The delay-line pad automatically compensates for external delay changes as small as plus or minus 8 mμsec at a rate of 75 mμsec/second. The delay-line memory stores 192 bits which are available serially with an access time of 125 μsec. ***D. A. Aaronson and D. B. James.*** *IRE Transactions on Electronic Computers,* v. EC-9, no. 3, Sept. 1960, p. 329-332. (TK1 In6.6e Vis.)

Fluxlok—A Nondestructive, Random-Access Electrically Alterable, High-Speed Memory Technique Using Standard Ferrite Memory Cores. The Fluxlok memory technique uses the principle of cross-field magnetization to achieve the nondestructive sensing of the information state of standard, readily available, ferrite memory cores in a simply-wired memory plane. Bipolar output (ONE and ZERO) signals are obtained at the rate of rise of the READ pulse. ***Robert M. Tillman.*** *IRE Transactions on Electronic Computers,* v. EC-9, no. 3, Sept. 1960, p. 323-328. (TK1 In6.6e Vis.)

A Thin Magnetic Film Shift Register. An initial application of the dynamics and interactions of domains within continuous magnetic thin film structures is made to a shift register in which binary information is stored and translated in and along a continuous evaporated thin magnetic film. ***Kent D. Broadbent.*** *IRE Transactions of Electronic Computers,* v. EC-9, no. 3, Sept. 1960, p. 321-323. (TK1 In6.6e Vis.)

A Solution to the Euler Angle Transformation Equations. A specially designed computer for solving the coordinate transformation equations normally encountered in a six degree of freedom simulation study. This computer expands the capabilities of present analog computer consoles and eliminates the tedious task of patching the solution to these equations, while eliminating a source of human error. ***Gilbert R. Grado.*** *IRE Transactions on Electronic Computers,* v. EC-9, no. 3, Sept. 1960, p. 362-369. (TK1 In6.6e Vis.)

A Feedback Method for Obtaining a Synchro Output Signal Proportional to Input Angle θ for Large θ. If the ac signal at the "cosine" terminal of a sinecosine resolver is fed back to the rotor through an amplifier of suitable grain, the signal at the "sine" terminal can be made proportional to rotor rotation for angles up to 90° or greater. ***M. B. Broughton.*** *IRE Transactions on Electronic Computers,* v. EC-9, no. 3, Sept. 1960, p. 359-362. (TK1 In6.6e Vis.)

A Critical Review of Electronic Control Systems. The millivolt-DC system requires minimum maintenance and a minimum of understanding of electronic systems by the user, will ride through power failures, provides the board operator with the system for automatic control or manual control that he needs, and has some other advantages. ***Ward F. O'Connor.*** *Instruments and Control Systems,* v. 33, Oct. 1960, p. 1742-1744.

* **A Duality Theorem for Convex Programs.** A proof is given for a duality theorem for a class of convex programs, i.e., constrained minimization of convex functions. A simple example is included. ***W. S. Dorn.*** *IBM Journal of Research and Development,* v. 4, no. 4, Oct. 1960, p. 407-413.

Tunnel Diode Digital Circuitry. Basic tunnel diode logic circuits are discussed. These include the monostable and the bistable analog-threshold gates and the "Gotopair", which uses the principle of majority decision. The results indicate that the "Gotopair" is somewhat superior to the analog-threshold gates. A tunnel diode flip-flop stage which has advantages with respect to speed, ease of operation, and component tolerances is described. ***W. F. Chow.*** *IRE Transactions on Electronic Computers,* v. EC-9, no. 3, Sept. 1960, p. 295-301. (TK1 In6.6e Vis.)

ELECTRICAL ENGINEERING

* **Thermistors, Their Theory, Manufacture and Application.** Describes the theory of operation of thermistors, explains why they, in common with other semiconductor devices, possess a negative temperature coefficient of resistance, and develops the expressions which govern their parameters. Methods of manufacture of the various forms of thermistor are outlined in general terms, and numerous applications of the device are discussed. ***R. W. A. Scarr and R. A. Setterington.*** *Institution of Electrical Engineers, Proceedings,* v. 107, pt. B, no. 35, Sept. 1960, p. 395-409.

Monotone Networks. Fundamental existence and uniqueness theorems for electrical networks of nonlinear resistors are proved in an abstract form, as theorems of pure mathematics. The two groups from which the "currents" and "voltage drops" are drawn are permitted to be either the real numbers, or discrete subgroups of the reals. It is found that the uniqueness theory is derivable from extremum principles for certain convex functions associated with the networks, and that the existence theory is derivable from a single new theorem of graph theory. ***G. J. Minty.*** *Royal Society, Proceedings,* v. 257, ser. A., Sept. 6, 1960, p. 194-212.

Electronics for Spectroscopists. Discusses: alternating-current theory, the RC-coupled amplifier stage, negative feedback, selective and direct-current amplifiers, power supplies, noise, amplifier design and fault finding, the application of semiconductors to the detection of radiation, detector and amplifier systems in infrared spectrometry, photoelectric devices and their application in the visible and ultraviolet regions and other problems. ***C. G. Cannon, editor.*** 333 pp. 1960. Interscience Publishers, New York. (TK7815 C16e)

Method of Calculating the Cost of Energy Losses in Electricity Supply Systems. Discusses cost of losses in: an all-thermal system, an all-hydroelectric system, a combined hydrothermal system; and accuracy of method of calculation. ***A. P. Mackerras and J. B. Kirkwood.*** *Engineer's Digest,* v. 21, Sept. 1960, p. 105-108.

The Distribution of Temperature Along Electrically Heated Tubes and Coils. I. Theoretical. The major new factor that appears here is the radiational transfer of energy in the core of the tube. The expression for the conductivity of the core bears a close analogy to the corresponding expression for other transport phenomena in which the mean free path of the diffusing particle is limited by the dimensions of the medium or of the enclosure, e.g., the thermal conductivity of a hot gas in a narrow tube due to the diffusion of the photons emitted by the molecules, or the thermal phonons. The case of a closely wound coil is very similar to that of the tube, except that the conductivity through the material of the walls is now through the wire and hence much smaller than in the tube. ***K. S. Krishnan and R. Sundaram.*** *Royal Society, Proceedings,* v. 257, ser. A, Sept. 20, 1960, p. 302-315.

* **Adjustable Silicon Rectifiers.** The construction and mode of operation of the adjustable silicon rectifier, as a new semiconductor constructional component, are explained and compared with a thyratron. A rectifier apparatus constructed with these rectifiers, with a constant-voltage, constant-current characteristic, is described with the aid of a circuit diagram. The regulators for current and voltage have integral behavior and act on a pulse generator which in turn controls the adjustable silicon rectifier. (*In German.*) Steuerbare Silizium-Gleichrichter. ***Joachim Balkow, Helmut Löwel, and Franz Reitwiessner.*** *ETZ: Elektrotechnische Zeitschrift,* v. 12, Ausgabe B, no. 19, Sept. 1960, p. 455-457.

* **On the Switching Time of Subharmonic Oscillators.** The time necessary to change the phase of an idealized subharmonic parametric oscillator from one value to a value differing by 180° is calculated for various values of pump power and switching power. Several conclusions are drawn from the results. ***A. H. Nethercot, Jr.*** *IBM Journal of Research and Development,* v. 4, no. 4, Oct. 1960, p. 402-406.

* **Increasing the Brightness-Voltage Nonlinearity of Electroluminescent Devices.** It has been shown that marked improvement in EL *B-V* nonlinearity and greatly enhanced *DR*'s can be obtained by the inclusion of SiC resistive layers in series with EL elements. Variations in *B-V* characteristics reflect variations in the properties of the applied SiC layer. ***J. A. O'Connell and B. Narken.*** *IBM Journal of Research and Development,* v. 4, no. 4, Oct. 1960, p. 426-429.

ELECTROCHEMISTRY

*** Study of the Electrochemical Properties of the System Potassium Fluorotitanate-Sodium Chloride-Titanium Dioxide.** On the basis of the polarization curves obtained by means of a Ag comparison electrode, it is shown that Ti is produced during the electrolysis of a melted K_2TiF_6-NaCl-TiO_2 system. The mechanism of the cathodic process consists in the discharge of Na ions, in the reduction by Na of the TiF_6 ion to TiF_6^{-3}, and in the discharge of TiF_6^{-3} ions with production of Ti. (*In Russian.*) Izuchenie elektrokhimicheskikh svoĭstv sistemy flortitanat kaliia-khloristyĭ natrii-dvuokis' titana. ***I. P. Badrin and A. A. Kazain.*** *Akademiia Nauk SSSR, Otdelenie Tekhnicheskikh Nauk, Izvestita, Metallurgiia i Toplivo,* 1960, no. 4, July-Aug., p. 3-8.

Preparation of Boron by Fused Salt Electrolysis. The preparation of elemental B by fused salt electrolysis was investigated using various electrolytes composed of B_2O_3 dissolved in mixtures of alkali metal and magnesium chlorides, fluorides and oxides, with a graphite crucible anode and a steel cathode at about 850 C. The best product purity, 97.5%, was obtained with a bath containing KCl, KF, and B_2O_3, treated with HCl gas. This electrolyte has the advantage that it is not as volatile as previously used baths containing KBF_4. Lower purities were obtained with baths containing Na or Mg salts. An approximate phase equilibrium diagram is given of the liquid system KCl-KF-B_2O_3. ***Nelson P. Nies.*** *Electrochemical Society, Journal,* v. 107, Oct. 1960, p. 817-820.

*** Fluoborates in Plating.** Uses, bath compositions, and operating data for Pb, Sn, Pb-Sn, Ni, and Zn fluoborates. ***F. Wild.*** *Electroplating and Metal Finishing,* v. 13, Oct. 1960, p. 373-377.

Fused Salt Electrorefining of Beryllium. Equipment and operating procedure. ***M. M. Wong, R. E. Campbell, and D. H. Baker, Jr.*** *Journal of Metals,* v. 12, Oct. 1960, p. 786-788.

Higher Purity Ingot Cerium From Molten Salts. An evaluation of several critical factors in the electrowinning of Ce. ***B. Porter, E. S. Shedd, C. Wyche, J. D. Marchant, and R. G. Knickerbocker.*** *Journal of Metals,* v. 12, Oct. 1960, p. 798-801.

*** The Preparation of Thorium Alloys by Electrolysis Using Fused Cathode and Exchange Reaction in Fused Salt.** Reports experiments on the preparation of Zn-Th, Bi-Th, Al-Th, and Mg-Th by electrolysis using fused cathode and exchange reaction in fused salt. The emphasis is on the possibility of commercial development of these processes. ***Yoshiki Ogawa, Yoshihiro Hisamatsu, and Kazutaka Kawamura.*** *National Research Institute for Metals, Transactions,* v. 2, no. 1, 1960, p. 37-42.

Hydrogen Embrittlement of Cadmium Plated Spring Steel. Reports results of research to determine optimum processing and plating procedures to minimize H embrittlement in plated steel springs. The data support the conclusion that Cd plating does not measurably embrittle spring steel, and disclose a safe cleaning and etching procedure. Harmful preplating treatments are described along with an effective baking procedure to relieve embrittlement. The slight sensitivity of spring steel to delayed fracture and fatigue failure, and the efficacy of several test methods for H embrittlement are established. ***J. A. Gurklis, L. D. McGraw, and C. L. Faust.*** *Plating,* v. 47, Oct. 1960, p. 1146-1154.

Zinc Plating of Carbonitrided Steel. Suggests a mechanism for the difficulty met in barrel plating and explains why the phenomenon is not found when the same parts are rack plated. ***Leonard R. Kohan and Howard T. Francis.*** *Plating,* v. 47, Oct. 1960, p. 1155-1158.

Constant Wattage Hard Anodizing of Aluminum. The work covered concerns a study of hard anodic coatings of one of 4 mils applied to 6061-T6 aluminum alloy using constant wattage dc power, in place of the constant current source presently employed in the hard anodizing industry. A study was made of the effects of temperature, wattage, and treatment time on the rate of build-up to the anodic coating, and their relation to abrasion resistance and dielectric breakdown voltage. A comparison was made between the properties obtained from hard

anodized coatings applied with the use of constant wattage to those obtained from the Martin Hard Coating Process and the Aluminum Company of America's Alumilite No. 226 Process. ***Martin A. Blumenfeld and W. Fred Schurig.*** *Plating,* v. 47, Oct. 1960, p. 1159-1165.

*** Electric Melting of Type 18KhNVA Structural Steel From Alloy Scrap.** The use of O and complex deoxidizers makes it possible to effect a marked reduction in the reducing period in the electric melting of structural steels from an alloy scrap charge. ***F. P. Edneral, I. Kh. Kutuev, and R. I. Kolyasnikova.*** *Stal' in English,* 1960, no. 5, May, p. 340-345.

ELECTRONICS

*** A Slot-Excited Corner Reflector for Use in Band V (610-960 Mc/s).** The directional aerial described employs a corner reflector excited by a four-tier slotted cylinder. It was used during a series of test transmissions in Band V (610-960 Mc/s) which required an aerial capable of withstanding severe climatic conditions for long periods without attention. A design suitable for operation at 900 Mc/s is described. ***D. J. Whythe and K. W. T. Hughes.*** *Institution of Electrical Engineers, Proceedings,* v. 107, pt. B, no. 35, Sept. 1960, p. 431-434.

*** V.H.F. Sound Broadcasting.** Describes the results of tests which were carried out in simulated multi-path conditions to determine the importance of the parameters of both the received signal and the receiver in influencing the subjective annoyance caused by the distortion. The use of pre- and de-emphasis appreciably reduces the distortion. ***R. V. Harvey.*** *Institution of Electrical Engineers, Proceedings,* v. 107, pt. B, no. 35, Sept. 1960, p. 412-422.

*** On the Determination of the Extrinsic Equivalent Circuit Parameters of Drift Transistors.** Methods of determining the "effective" extrinsic base resistance and collector capacitance of alloy-junction and diffused-type of graded-base transistors are presented. These methods involve measurements of the common-base short-circuit output and input admittances at frequencies much less than the cut-off frequency of the transistor and are particularly suitable for devices where the base contact is made very close to the emitter. ***M. B. Das.*** *Journal of Electronics and Control,* v. 8, no. 5, May 1960, p. 351-363.

*** Analysis of Modulated Travelling-Wave Devices and Beam-Type Parametric Amplifiers.** Modulations are considered at frequencies both very much lower and also at those comparable to the carrier frequency. The analysis includes modulation effects on *C*, *QC*, *b*, *d*, and the initial wave amplitudes. Lower gain and more noise than found by previous theories is predicted. ***H. Sobol and J. E. Rowe.*** *Journal of Electronics and Control,* v. 8, no. 5, May 1960, p. 321-349.

*** A Study of Aperture-Type Electron Lenses With Space Charge.** The electron optical action of round and slit apertures in the anodes of parallel-plane diodes is investigated. The influence of aperture size on the space-charge-limited current is calculated and included in the determination of paraxial electron trajectories. The results computed by machine are expressed in terms of an effective thin lens whose position and strength are modified from the usual values. ***L. A. Harris.*** *Journal of Electronics and Control,* v. 8, no. 4, Apr. 1960, p. 241-265.

An Alternative Approach to the Realization of Network Transfer Functions: The *N*-Path Filter. A particular time-varying network consisting of several parallel transmission paths, each containing input and output modulators, is described and analyzed. Shows that under certain conditions, the network may be characterized by a transfer function. A particular form of this transfer function yields periodic filtering characteristics over a limited frequency band without employing distributed elements. ***L. E. Franks and I. W. Sandberg.*** *Bell System Technical Journal,* v. 39, no. 5, Sept. 1960, p. 1321-1350.

Electromechanical Devices and Systems for Electronics. Discusses relays and related devices, contact capsules for switching, trends in mechanical switching, rotating electromechanical devices, actuators and timers, electromechanical readout. ***Mi-***

chael F. Tomaino and George J. Flynn, editors. *Electronics*, v. 33, no. 40, Sept. 30, 1960, p. 57-80.

Design and Performance of Ultraprecise 2.5-mc Quartz Crystal Units. A 2.5-mc crystal unit was developed for use in a new, extremely stable frequency standard oscillator. A well-balanced design was achieved by using a 30-mm-diameter, plano-convex, polished quartz plate, coated with Au and operated on its fifth overtone. The new crystal unit makes possible oscillators characterized by excellent frequency stability, small and uniform aging and straightforward design. ***A. W. Warner.*** *Bell System Technical Journal*, v. 39, no. 5, Sept. 1960, p. 1193-1217.

Evaluation and Control of Diffused Impurity Layers in Germanium. The surface concentration of a diffused layer is shown to be approximately equal to the concentration in the source powder at high temperature and to decrease with decreasing temperature. Diffusion constants for As and Sb are determined by use of "sheet-resistance" and junction-penetration measurements. Because the surface concentration can be predicted within a factor of two, and the penetration within ten per cent, the present experiments show that the powder diffusion method is suitable for the fabrication of carefully controlled impurity layers. ***H. S. Veloric and W. J. Greig.*** *RCA Review*, v. 21, no. 3, Sept. 1960, p. 437-456.

On the Mechanism of Chemically Etching Germanium and Silicon. The electrode potential of Ge or Si in a chemical etching solution is a function of solution *p*H, rate of etching, physical condition of the surface, conductivity type, and resistivity. Results suggest that excess holes and electrons are produced at the surface of the semiconductor during chemical etching. Holes are injected at cathode sites, but only a portion of these holes are consumed at anode sites since the anode reaction involves current multiplication. ***D. R. Turner.*** *Electrochemical Society, Journal*, v. 107, Oct. 1960, p. 810-816.

Electroluminescence—A Disorder Phenomenon. In general, electroluminescence is considered to occur at a junction between a semiconducting crystal and a metal or electron rich material. The present work indicates that electroluminescence only occurs in zinc sulfide powders containing both sphalerite and wurtzite. This observation suggests that electroluminescence is a disorder phenomenon associated with stacking faults in the crystal. ***D. W. G. Ballentyne.*** *Electrochemical Society, Journal*, v. 107, Oct. 1960, p. 807-810.

* **Synthesis Techniques for Gain-Bandwidth Optimization in Passive Transducers.** The technique proposed here bypasses the problem of adjusting the parameters of an approximating function by producing from the idealized gain-bandwidth constraints a set of functions which specifies the equalizer alone. All load dependence is removed from the specifications as an initial step in the synthesis. The final transducer is then synthesized from the approximating functions which are obtained. ***H. J. Carlin.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1705-1714.

* **A Study of the Charge Control Parameters of Transistors.** Points out that only devices whose performance is determined by charges which are under the control of external circuitry can be regarded as charge controlled devices. This distinction strictly speaking excludes from the class of charge controlled devices those exhibiting the "wiggle" effect or possessing carrier storage in the collector region during operation in saturation. ***J. J. Sparkes.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1696-1705.

* **Forward Scattering by Coated Objects Illuminated by Short Wavelength Radar.** Theoretical and experimental results are presented concerning the ineffectiveness for forward scattering of radar absorbing coatings applied to highly conducting objects which are large with respect to the wavelength of the incident energy. ***R. E. Hiatt and K. M. Siegel.*** *I.R.E. Proceedings*, v. 48, Sept. 1960, p. 1630-1635.

* **The Ineffectiveness of Absorbing Coatings on Conducting Objects Illuminated by Long Wavelength Radar.** Shows that thin coatings can have little effect on the Rayleigh scattering cross sections. Points out how the effect of conductivity is enhanced at low frequencies. ***R. E. Hiatt and K. M. Siegel.*** *I.R.E. Proceedings*, v. 48, Sept. 1960, p. 1636-1642.

Photoconductivity of Solids. A historical survey, electron process in crystals, photoconductivity processes, preparation of photoconductors, electrode effects, imperfection photoconductivity, energy bands and excitation transitions, free-carrier scattering and mobility, traps and trapping effects, recombination processes, theoretical viewpoints and photoconductivity and related topics are discussed. ***Richard H. Bube.*** 461 pp. 1960, John Wiley, New York. (QC716 B85p)

Electrical Noise. Fundamentals and Physical Mechanism. Discusses mathematical techniques, equipartition and Nyquist's theorem, statistical mechanics of Johnson noise, simple shot noise, the accelerating-field diode, thermionic emission and the retarding-field diode, the space-charge-controlled diode, grid-controlled amplifying valves, beam amplifiers, masers, the $1/f$ spectrum of current noise and other problems. ***D. A. Bell.*** 342 pp. 1960. D. Van Nostrand Co., New York. (TK7835 B41e)

Wave Propagation in a Random Medium. A systematic account of the influence of refractive index fluctuations on the characteristics of electromagnetic and acoustic waves propagating through the troposphere or the ocean. Among the problems receiving particular attention are amplitude and phase fluctuations of a plane wave as a function of the distance penetrated into the random medium and correlation between the fluctuations; and the influence of refractive index fluctuations on image formation in focusing systems. ***Lev A. Chernov.*** 168 pp. 1960. McGraw-Hill, New York. (QC231 C42rtr)

DOPLOC Tracking Determines Orbits of Satellites. Data from only a single pass of the satellite near a DOPLOC tracking system are sufficient for orbit computation. The whole process can be accomplished in 30 min. Other systems require hours, days or weeks of data collection before a computer can even be fed the information. Further, DOPLOC can do it on the first pass; the others cannot. ***L. G. DeBey.*** *Electronic Industries*, v. 19, Oct. 1960, p. 78-80.

Parametric Amplification by Junction Diodes. It was not feasible until recently to use voltage dependent variable capacitive elements as microwave amplifiers. Diodes with high Q, low loss, and low noise now make the application of this principle at high frequencies a natural evolution. ***Earle L. Steele.*** *Electronic Industries*, v. 19, Oct. 1960, p. 81-83.

Slow-Wave Structures for Electrostatically Focused High-Power Traveling-Wave Tubes. Two high-power slow-wave structures are described which have provisions for periodic electrostatic focusing of the electron beam. Both slow-wave circuits are of the backward-wave type and electrostatic focusing of the beam is accomplished by the insertion of additional focusing electrodes midway between the drift tubes of the original r-f structures. ***Erwin F. Belohoubek.*** *RCA Review*, v. 21, no. 3, Sept. 1960, p. 377-388.

Design Considerations for Grid-Controlled Electron Guns for Pulsed Traveling-Wave Tubes. Methods are suggested for the determination of grid parameters, current transmission, and cutoff amplification factor for the modified configuration. The methods of grid placement and associated design expressly for the convergent-flow gun have not previously been discussed. ***H. J. Wolkstein.*** *RCA Review*, v. 21, no. 3, Sept. 1960, p. 389-413.

The Magnetic Field and Flux Distributions in a Periodic Focusing Stack for Traveling-Wave Tubes. Values of demagnetizing field more than twice those computed conventionally have been measured in the space occupied by the magnets. Computations that take into account the contributions to the demagnetizing field of factors now neglected (i.e., the charges on the disc and the hub surface) yield results that are in very good agreement with measurements made upon actual fields in stack models. Contributions by neighboring magnets affect both the demagnetizing field and the axial field. The contributions to the demagnetizing field result in a shift of the operating point of the magnet. ***Max J. Schindler.*** *RCA Review*, v. 21, no. 3, Sept. 1960, p. 414-436.

* **Free Radicals in Gamma-Irradiated Polystyrenes.** Electron spin resonance spectra were observed for γ-irradiated polystyrene and for substituted polystyrenes. The spectra of all the *d*-substituted styrenes irradiated at 77 K were nearly identical. The result is consistent with a radical structure formed by re-

moval of α-H and a major hyperfine interaction with the ortho ring hydrogens. The same structure seems to apply for γ-irradiated poly(m-methylstyrene) and poly(α,β,β-trifluorostyrene), but in poly(2,5-dichlorostyrene) all hyperfine interactions are much lower. The radical from poly(α-methylstyrene) is formed by main-chain scission and shows evidence for relatively free rotation of the α-methyl group. ***Roland E. Florin, Leo A. Wall, and Daniel W. Brown.*** *Faraday Society, Transactions*, v. 56, Sept. 1960, p. 1304-1310.

1959 National Telemetering Conference. Discusses communication efficiency of space telemetry systems, comparative merits of analog and digital telemetering, new developments in the PCM telemetry, the influence of FM-FM telemetry component characteristics on system performance, a comparison of an identical vacuum tube and transistor telemetry system, a system approach to a low cost telemeter, and other problems. 411 pp. 1959. American Institute of Electrical Engineers, New York. (TK399 N21p)

* **Automatic Phase Control: Theory and Design.** Automatic Phase Control (APC) systems with sinusoidal reference are analyzed, and design criteria are presented. The limit of the pull-in range is derived; the result is believed to be novel, and is found to be in agreement with experiment. ***T. J. Rey.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1760-1771.

* **High Selectivity With Constant Phase Over the Pass Band.** The method of phase compensation is not restricted to a particular frequency range or a particular type of circuitry. What is needed in addition to conventional circuitry without phase compensation is a local oscillator and simple mixers. The method was developed for the slow frequency variations in Doppler systems, but should also be applicable to the rapid variations of frequency or phase modulation, where a phase change with frequency may be undesirable in some applications. ***August W. Rihaczek.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1756-1760.

* **The DC Pumped Quadrupole Amplifier—A Wave Analysis.** Analyzes the dc pumped twisted-quadrupole amplifier in terms of the four transverse beam waves and their coupling. Amplification is found to result from the coupling of the slow and fast cyclotron waves. The pump voltage does not actually pump, i.e., does not supply energy. ***A. E. Siegman.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1750-1755.

* **Analytical Studies on Effects of Surface Recombination on the Current Amplification Factor of Alloy Junction and Surface Barrier Transistors.** Analytical formulas for various idealized geometries are derived by means of approximating methods. From these results, many useful design data, such as the optimum radius ratio of the emitter electrode and the collector are obtained and the effect of curvature of the electrode surfaces is made clear. The survival factor can be expressed by four dimensionless quantities, thus establishing the principle of similitude among transistors having different surface recombination velocities and different geometrical dimensions of electrodes. ***T. Sugano and H. Yanai.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1739-1749.

* **A Vacuum Evaporated Random Access Memory.** The basic multiple-layer magnetic thin film structure described was shown to have special and desirable properties in coincident-signal switching applications such as those employed in binary random access memories. Its demonstrated advantages in this application include: magnetic turnover times as low as 30 mμsec; wide latitude in selection currents; and others. ***K. D. Broadbent.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1728-1731.

* **Properties of Phased Arrays.** The study uses contour maps of the antenna pattern in "sin θ-space", which is a projection of the unit sphere on the plane of the array. Using a parallel projection of the unit sphere onto the plane of the array, the actual antenna patterns are then readily obtained in conventional spherical coordinates. This method also permits ready evaluation of the influence of the directivity of the radiating elements. ***Wilhelm H. Von Aulock.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1715-1727.

Getting High Range Resolution With Pulse Compression Radar. High range resolution is ordinarily achieved by reducing the pulse length, requiring an increase of peak pulse power. By transmitting a stretched pulse and compressing the received pulse, a shorter pulse with high effective peak power is obtained. ***Gunnar P. Ohman.*** *Electronics*, v. 33, no. 41, Oct. 7, 1960, p. 53-57.

a

* **An Improved Automatic Method for Measurement of Ionospheric Absorption.** The equipment described is an improvement of an earlier model recording the mean echo amplitude over an interval of about one minute. The whole system is synchronized to one-pulse-per-second trigger voltages, thus providing improved compensation for background noise signals and the minimum interference with other services. The general performance of the equipment is discussed. ***L. Thomas.*** *Electronic Engineering*, v. 32, Oct. 1960, p. 635-639.

b

* **The Use of the Silicon Resistor in the D.C. Stabilization of Transistor Circuits.** A new method of stabilizing the d.c. operating point of transistors, using the Si resistor, is introduced and its application to both small-signal and power transistors is expounded. Practical evidence is given to show that it is possible, with this method, to obtain constant collector current over the whole operating temperature range of transistors in the great majority of cases. ***D. H. Mehrtens and J. T. Zakrzewski.*** *Electronic Engineering*, v. 32, Oct. 1960, p. 624-629.

c

* **Analytical Studies on Effects of Surface Recombination on the Current Amplification Factor of Alloy Junction and Surface Barrier Transistors.** Analytical formulas for various idealized geometries are derived by means of approximating methods. From these results, many useful design data such as the optimum radius ratio of the emitter electrode and the collector are obtained, and the effect of curvature of the electrode surfaces is made clear. The survival factor can be expressed by four dimensionless quantities. The values of β calculated from these formulas are in good agreement with the experimental values previously obtained by Stripp and Moore from an analogy of three-dimensional electrolytic conductance. ***T. Sugano and H. Yanai.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1739-1749.

d

e

* **Shot and Thermal Noise in Germanium and Silicon Transistors at High-Level Current Injections.** The case of shot noise at high-current densities is tackled for the first time, obtaining formulas in good agreement with experimental values. The crux of the new theory is the introduction of an equivalent circuit for *p-n* junctions, containing an inductance besides resistances and capacitances. ***B. Schneider and M. J. O. Strutt.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1731-1739.

f

* **A Vacuum Evaporated Random Access Memory.** The basic multiple-layer magnetic thin film structure described here has been shown to have special and desirable properties in coincident-signal switching applications such as those employed in binary random access memories. ***K. D. Broadbent.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1728-1731.

g

* **Properties of Phased Arrays.** Discusses the scanning properties of planar and linear phased arrays consisting of a large number of equispaced radiators, either omnidirectional or directive. This method permits ready evaluation of the influence of the directivity of the radiating elements, including a slight shift of the beam maximum with respect to that of an array of isotropic radiators. A pictorial representation of the coverage of a tilted planar array of given scanning properties can be obtained in terms of an earth-fixed coordinate system. ***Wilhelm H. Von Aulock.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1715-1727.

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* **Synthesis Techniques for Gain-Bandwidth Optimization in Passive Transducers.** Methods proposed up till now prescribe an approximating transfer function which includes the load characteristics, and the problem of adjusting the parameters of such an approximating function is quite formidable. The technique proposed here bypasses this problem by producing from the idealized gain-bandwidth constraints a set of functions which specifies the equalizer alone. The final transducer is then synthesized from the approximating functions which are obtained. ***H. J. Carlin.*** *I.R.E. Proceedings*, v. 48, Oct. 1960, p. 1705-1714.

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* **A Study of the Charge Control Parameters of Transistors.** A distinction is drawn between the technique of charge analysis of transistor action, and the concept of charge control of transistor performance. It is pointed out that only devices whose performance is determined by charges which are under the control of external circuitry can be regarded as charge-controlled de-

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vices. This distinction excludes from the class of charge-controlled devices those exhibiting the "wiggle" effect or possessing carrier storage in the collector region during operation in saturation. ***J. J. Sparkes.*** *I.R.E. Proceedings,* v. 48, Oct. 1960, p. 1696-1705.

Improved Communications Using Groundscatter Propagation. Describes instrumentation for research into the propagation phenomena creating these paths and gives results of investigations. ***R. T. Wolfram.*** *Electronics,* v. 33, no. 44, Oct. 28, 1960, p. 74-78.

* **Automatic Phase Control: Theory and Design.** Automatic Phase Control (APC) systems with sinusoidal reference are analyzed, and design criteria are presented. The limit of the pull-in range is derived; the result is believed to be novel, and is found to be in agreement with experiment. ***T. J. Rey.*** *I.R.E. Proceedings,* v. 48, Oct. 1960, p. 1760-1771.

* **High Selectivity With Constant Phase Over the Pass Band.** The signal frequency is inverted by means of a mixer, and the signal is passed through a filter to create a phase shift in one direction. The signal frequency is then reinverted in another mixer, and the resulting signal is again passed through a filter which now effects a phase change in the opposite direction. By properly choosing the filter constants and combining the two signals, the two phase shifts will compensate each other. ***August W. Rihaczek.*** *I.R.E. Proceedings,* v. 48, Oct. 1960, p. 1756-1760.

Studies of Auger Electrons Ejected From Germanium by Slowly Moving Positive Ions. Measurements have been made of total yield and kinetic energy distribution of Auger electrons ejected from a Ge surface by singly charged noble gas ions. By this means, surface changes have been monitored during procedures designed to clean the surface. Ion bombardment yielded a reproducible surface which showed the Auger characteristics to be expected for the clean surface. Heating at lower temperatures for days and for a total of about 3 hr at 1170 K (40° below the melting point) prior to any sputtering only partially cleaned the surface. From the kinetic energy distribution of the Auger electrons some of the principal characteristics of the state density function in the valence band of Ge have been determined. ***H. D. Hagstrum.*** *Physics and Chemistry of Solids,* v. 14, July 1960, p. 33-36.

The Design of Varactor Diodes. The product of diode cutoff frequency and capacitance-voltage sensitivity constitutes a figure of merit for varactor diodes which is inversely proportional to the product of the rise time and the pump power dissipation in a parametric subharmonic oscillator. Favorable diode designs embody a low-resistance base region supporting a narrow and sparsely doped junction depletion layer. Shallow alloy junctions can be improved by outdiffusion of the base wafer until the surface concentration is 30% of the initial concentration. ***J. Hilibrand and C. F. Stocker.*** *RCA Review,* v. 21, no. 3, Sept. 1960, p. 457-474.

* **Radiation and Admittance of an Insulated Slotted-Sphere Antenna Surrounded by a Strongly Ionized Plasma Sheath.** ***John W. Marini.*** *U. S. National Bureau of Standards, Journal of Research, Section D, Radio Propagation,* v. 64D, no. 5, Sept.-Oct. 1960, p. 525-532.

Project Score—The First Satellite Communication System. The performed experiments included initially, transmission of President Eisenhower's message in voice followed by one channel teletype code, using delayed repeater. Then followed direct relay of California's communication site identification in voice, followed by the President's message in teletype code. Finally, a multichannel teletype transmission by delayed repeater was performed, the first successful delayed repeater communication from earth to satellite to another point on earth at a later time. ***George V. Kedrowsky.*** *Aero/Space Engineering,* v. 19, Oct. 1960, p. 36 + 5 pages.

Contact Electrification of Semiconductors. Recently published experimental findings on the electrification of rutile powder by sliding down a metal chute can be explained by an extension of the separation electrification of metals. The mechanism of the electrification of insulators must, in most cases, be quite different. ***W. R. Harper.*** *British Journal of Applied Physics,* v. 11, Aug. 1960, p. 324-331.

* **Piezomagnetic Ferrites.** Applications in filters and ultrasonics are given. The survey of the principal potential applications of piezomagnetic ferrites, criteria for piezomagnetic transducer materials, and ferrite transducers as efficient power radiators in ultrasonic cleaning equipment are discussed. ***C. M. van der Burgt.*** *Electronic Technology,* v. 37, Sept. 1960, p. 330-341.

Donor Concentration at the Surface of a Diffused N-Type Layer on P-Type Germanium. Four methods of evaluating the donor concentration at the surface of a diffused N-type layer on P-type Ge were investigated. All methods assumed a complementary error function (erfc) distribution in the diffused layer. ***R. Glang and W. B. Easton.*** *Electrochemical Society, Journal,* v. 107, Sept. 1960, p. 758-763.

* **Thin-Film Cryotrons. I. Properties of Thin Superconducting Films. II. Cryotron Characteristics and Circuit Applications. III. An Analysis of Cryotron Ring Oscillators.** Describes the characteristics of evaporated superconductive films as they apply to cryotrons. Their current-carrying capacity has been found to be proportional to width and proportional to thickness when the film is thinner than twice the penetration depth. The superconducting to normal transition in a tin gate 0.125 inch wide and 3×10^{-5} cm thick is controlled by current in a single lead control, 0.006 inch wide, which crosses the gate. Silicon monoxide is used for insulation. It is important to reduce the inductance. The analysis is concerned with the frequency-L/R time constant and circuit resistance-gate resistance relationships so that the results of measurements on oscillators can be properly interpreted. I. ***C. R. Smallman.*** II. ***A. E. Slade.*** III. ***M. L. Cohen.*** *I.R.E. Proceedings,* v. 48, Sept. 1960, p. 1562-1582.

* **Non-Periodic Slow-Wave and Backward-Wave Structures.** The behavior of the phase constant as a function of frequency is examined in the neighborhood of cut-off for a waveguide of circular cross-section containing a concentric rod of dielectric or ferrite material. It is predicted from this behavior that with suitable choices of geometry and properties of the rod, slow waves or backward waves will propagate. ***P. J. B. Clarricoats and R. A. Waldron.*** *Journal of Electronics and Control,* v. 8, no. 6, June 1960, p. 455-458.

* **Excitation in a Transient Arc Discharge.** The intensity ratio of two Cu emission lines was measured as a function of time for a transient arc in free air, using two photomultipliers simultaneously. The results are compatible with the thermal nature of the high-pressure arc, but indicate that for temperature measurement the usual assumption of Boltzmann populations may not be sufficient in an unsteady discharge of this type. ***A. M. Howatson.*** *Journal of Electronics and Control,* v. 8, no. 6, June 1960, p. 441-447.

* **A Grid-Controlled Electron Multiplier Tube.** The properties of an experimental grid-controlled photo-multiplier tube were investigated and, under pulsed operation, a transfer conductance of 60 mA/volt was achieved. The primary electron current was produced by placing a suitable scintillator near the photocathode and energizing it by means of a radioactive source of ^{90}Sr. This resulted in a substantially constant illumination of the photo-cathode and, because of the long half-life of the ^{90}Sr, high long-term stability for the production of the primary electron current. ***D. C. Brown and M. F. Penny.*** *Journal of Electronics and Control,* v. 8, no. 6, June 1960, p. 431-439.

USAF Goes to Wide-Band for Global Communication Net. New orders of reliability, transmission time, and capacity are the goals for USAF's 480-L wide-band air communications system, now under design to meet our needs over the next decade. ***Harold R. Johnson.*** *Space/Aeronautics,* v. 34, no. 4, Oct. 1960, p. 220-222.

A New Design for Power Resistors. A typical redesign, resulting in important savings to the Bell System, was the new 19-type resistor, which replaced the former 18-type resistor. ***R. J. Wirtz.*** *Bell Laboratories Record,* v. 38, Oct. 1960, p. 385-388.

Telephone Circuits: A New Link in Data Communications. Machines, speaking the language called data, can use voice-band telephone circuits as an effective channel of communication. To integrate data with a voice-band system, the communications engineer must carefully consider the capabilities

of the telephone system. ***J. M. Wier.*** *Bell Laboratories Record,* v. 38, Oct. 1960, p. 368-372.

*** Radio-Frequency Forced Oscillations in Non-Uniform Plasmas.** A wave equation and associated equations is derived for periodic forced oscillations in a collision-free plasma. This set of equations is rather complicated and small signal approximations are derived, which are applicable to plasma-confinement problems. One approximation is applied to the case of a fast E_0 travelling wave in plasma, and its behavior is shown to be markedly different from the well-known case of an E_0-wave at cut-off. Some difficulties with small signal theories are indicated and the need for further clarification pointed out. ***R. B. R.-Shersby-Harvie.*** *Journal of Electronics and Control,* v. 8, no. 6, June 1960, p. 421-430.

*** Instability Effects in High-Power C. W. Klystrons.** Some instability effects observed in a four-cavity 2kw X-band C. W. klystron amplifier with an efficiency of 40%, are described. An explanation of them is given, and it is shown that this is capable of accounting for all the major effects observed. The influence of these effects on the design of high-power C. W. klystrons is discussed. ***J. C. Vokes and C. P. Lea-Wilson.*** *Journal of Electronics and Control,* v. 8, no. 6, June 1960, p. 401-419.

Free Carrier Absorption Due to Polar Modes in the III-V Compound Semiconductors. The longitudinal polar modes of vibration in the III-V compound semiconductors play an important part in determining their transport properties, such as mobility. One would, therefore, expect them to be important for free carrier absorption, as well, in these semiconductors. A quantum mechanical calculation of the free carrier absorption arising from these modes has been made and gives an absorption varying as $\lambda^{2.5}$, and such behavior has been reported experimentally in InP and GaP. The calculated value of the absorption coeffiicent in InP is in good agreement with experiment. ***S. Visvanathan.*** *Physical Review,* v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 376-378.

Free Carrier Absorption Arising From Impurities in Semiconductors. The free carrier absorption due to ionized impurities in semiconductors is essentially the inverse process of bremsstrahlung. The cross section for bremsstrahlung is readily available in the literature, and one can calculate the spectral distribution of bremsstrahlung for the carriers in a semiconductor; furthermore, by using Kirchhoff's law of radiation, relating the emission and absorption in the semiconductor, one arrives quite easily at the absorption coefficient. The results so obtained agree with those of previous authors who have used a different method of calculation. The inadequacy of the Born approximation in the calculation of the ionized impurity effects on free carrier absorption is brought out clearly. ***S. Visvanathan.*** *Physical Review,* v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 379-380.

Theory of the Ettingshausen Effect in Semiconductors. The Ettingshausen effect in semiconductors is mainly due to the generation of electron-hole pairs at one side of the sample and their recombination at the other side. The Ettingshausen coefficient is calculated, in agreement with Putley, as $P = (E_g/kec)z(1+z)^{-2}(\mu_e+\mu_h)$ where $z = (n_h\mu_h/n_e\mu_e)$-ratio of hole conductivity to electron conductivity. E_g is the gap energy, and k the thermal conductivity. Discusses this formula for intrinsic, p-type and n-type semiconductors. P goes through a maximum for p-type semiconductors near the temperature at which the Hall voltage goes through zero. Results agree reasonably well with the measurements of Mette, Gärtner, and Loscoe of P as a function of temperature for different samples of Ge and Si. ***B. V. Paranjape and J. S. Levinger.*** *Physical Review,* v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 437-441.

Systems Applications of Solid-State Masers. Survey of progress in solid-state masers describes applications, possible new materials, and future trends. Also, principles of maser operation and circuit design are outlined. ***James W. Meyer.*** *Electronics,* v. 33, no. 45, Nov. 4, 1960, p. 58-63.

Automation for Quality Control Testing of Electron Tubes. In an effort to hold down the rapidly mounting costs of quality testing and data evaluation, to improve operator accuracy, and to reduce the number of tests, a test set has been developed which performs many of the tests automatically. The set provides digital data output for each test on each tube in

punched tape, reads out the tape, and prints a copy of the punched data. ***Roy A. McNaughton.*** *IRE Transactions on Reliability and Quality Control,* v. RQC-9, Sept. 1960, p. 16-22. (TK1 In6.6q Vis.)

Quantitative Considerations Concerning Catalysis at a Semiconductor Surface. The theory of charge-transfer catalysis, originally proposed by Wagner and Hauffe, is set up in quantitative form. The objects of the treatment are to write down quantitative expressions for the absolute reaction rate, to show what are the consequences of the Wagner-Hauffe mechanism insofar as they concern the adsorption properties of the individual reacting materials, and to outline an experimental program for determining, by means of experiments on the semiconductor, alone and in association with each of the reacting substances in turn, the values prevailing in a practical case for the various parameters occurring in the theory. ***C. G. B. Garrett.*** *Journal of Chemical Physics,* v. 33, Oct. 1960, p. 966-979.

*** Shock Waves in Nonlinear Transmission Lines and Their Effect on Parametric Amplification.** It is pointed out that the shock wave will form in a distance which is short for any parametric amplification purposes. The subsequent growth of the shock and its decay, due to the inevitable dissipation associated with a shock, are analyzed assuming that the capacitance variations are small compared to the total capacitance. The propagation of a small deviation from a signal which is perfectly periodic in time is also examined, and it is shown that the small deviation may spread out in time but cannot be changed in its sign. ***R. Landauer.*** *IBM Journal of Research and Development,* v. 4, no. 4, Oct. 1960, p. 391-401.

ENGINEERING ECONOMICS

*** Quebec's Big Experiment: An Economic Council.** The Quebec government envisions an economic council which will be a form of planning board and may establish a new liaison between government and business. Agriculture, labor, as well as business, will be represented on this body whose purpose generally will be to advise the cabinet on economic policy, resource development, transportation and hydro. *Canadian Business,* v. 33, Oct. 1960, p. 36-37.

*** Why Spain Must Not Enter the Common European Market.** Industrially insufficiently developed countries, joining the market, run the risk of becoming economic colonies and losing the opportunity to develop a high economy of their own. Spain would lose her liberty to negotiate with the rest of the world according to her own interests and means. Her duty is not to complete the economy of others, but first to rebuild her own economical structure. The only financial help received by Spain from other countries did not come from Europe, but from the U.S. and from Brazil. (*In Spanish.*) Por qué España no debe entrar en el mercado común Europeo. ***Jose M. Vila-Coro de Nadal.*** *Acero y Energia,* v. 17, no. 99, May-June 1960, p. 153-162.

*** A Philosophy of Mineral Exploration.** Based upon structural geology in the broad sense of the term, this approach suggests a view broad enough to avoid getting overwhelmed by structural minutiae. Involves the well-founded assumption that many, if not most, economic mineral deposits are closely related to the major fractures in the crust of the earth, having used these openings as channel ways in their ascent from the depths, which we believe to be the ultimate source of heavy minerals. Our task, then, is to find out all we can about such fractures, their pattern and their mutual relationships. ***B. B. Brock.*** *Optima,* v. 10, no. 3, Sept. 1960, p. 143-158.

*** The Latin American Powder Keg.** The roots of poverty in this potentially rich continent are not in lack of land or resources, but in the ignorance of the masses and the shortsightedness of the few, in bad politics, and worse economics. ***G. C. Wiegand.*** *Business Horizons,* v. 3, no. 3, Fall 1960, p. 39-48.

Engineering Economy—The Analysis of Management Decisions. Sets forth the principal ideas treated in engineering economy, and includes a somewhat more general coverage of decisions under certainty. Emphasis is placed on the available

methods of collecting, handling, and utilizing the data which are used in engineering decisions. ***William T. Morris.*** 506 pp. 1960. Richard D. Irwin, Inc., Homewood, Ill. (TA183 M83e)

* **Pension Funds—Creator of Labor Obsolescence?** Private pension funds cover about one of every four persons in the civilian labor force. Already a potent factor, the funds are likely to have greater effects on our society in the future. How will they affect our economy—and the labor force? These questions must be answered before the problems become bigger than the benefits. ***Henry I. Kester and Harold A. Wolf.*** *Business Horizons,* v. 3, no. 3, Fall 1960, p. 70-76.

How Are Marketers Meeting the Import Challenge? Foreign companies have been beating U. S. firms in their own back yard and at their own selling game. For many American firms, the need seems to be for nothing short of a complete overhaul of marketing policies. ***James A. Hagler.*** *Harvard Business Review,* v. 38, no. 5, Sept.-Oct. 1960, p. 107-114.

Psychoanalytic Contributions to an Operational Research Study of Marketing. Contains a highly condensed psychological model of human behavior, with some particular reference to those branches of human behavior called "executive decision making" and "operational research". A model is constructed in which behavior is modally a function of selected conscious and unconscious needs, motivations and drives. Several experiences in which the concepts of the model and related techniques and insights to influence decisions and operational research methods are used. ***Herbert Holt and Melvin E. Salveson.*** *Operational Research Quarterly,* v. 11, no. 3, Sept. 1960, p. 151-161.

A Survey of the Natural Gas Industry in Canada, 1957-1959. ***R. A. Simpson and R. L. Borden.*** *Canada, Mines Branch, Mineral Information Bulletin MR* 39, 1960, 82 pp. (TN26 C16.55m Contin.)

* **The Prospects for U.S. Exports to the Common Market.** What are the prospects for American firms concerned with retaining or improving their share in the European common market area? For many producers, the common market is a challenge to remain competitive in design, quality, costs, and prices with foreign industry. ***Stephen Spiegelglas.*** *Business Horizons,* v. 3, no. 3, Fall 1960, p. 62-69.

Support for Under-Developed Countries. Advocates British private and governmental aid to under-developed nations. *Nature,* v. 187, Sept. 17, 1960, p. 971-973.

Minerals, Metals and Man. Far more of the world's mineral deposits were consumed in the past 50 years than throughout man's previous existence. While no grave trouble need be expected for several generations, there are already sound reasons for organizing international planning and research. ***C. W. Dannatt.*** *New Scientist,* v. 8, Sept. 15, 1960, p. 724-727.

* **The World Cobalt Situation.** Even if the worst imaginable (and now unforeseen) world events should cause world Co production to drop drastically for the next few years, the U. S. has an abundant supply of this metal in surplus stocks and stockpiles to feed industry at its present rate. In the meantime, plants now closed in the U. S. and Canada could be reactivated. The Cuban and Congo crises offer world politicians much more genuine cause for concern than they do U. S. consumers of Co. ***F. R. Morral.*** *Metals,* v. 31, no. 3, Sept. 1960, p. 7-8.

FLUID MECHANICS

Flow Behind Shock Waves in Conducting Gases. Proves that in addition to generating vorticity, the shock waves in conducting gases generate electric current also; the expression for vorticity in conducting gases, in contrast to nonconducting gases, depends on the thermodynamic behavior of the fluid. Furthermore, an interesting relation between the normal components of the vorticity and current density is discovered. ***R. P. Kanwal.*** *Royal Society, Proceedings,* v. 257, ser. A, Sept. 6, 1960, p. 263-268.

* **Flow Coefficient of Pipe Constrictions. II.** Flow coefficient and operational correction factors; comparison of theory with experimental results. ***T. H. Redding.*** *British Chemical Engineering,* v. 5, Oct. 1960, p. 714-722.

* **Effect of Liquid- and Gas-Mixing on the Rate of Mass Transfer Between Two Phases in Crosscurrent Flow.** ***Wataru Eguchi, Makoto Harada, and Shinji Nagata.*** *Kyoto University, Memoirs of the Faculty of Engineering,* v. 22, pt. 3, July 1960, p. 326-342.

Measurements of Heat Transfer and Friction Coefficients for Helium Flowing in a Tube at Surface Temperatures up to 5900 R. Measurements were made with He flowing through electrically heated smooth tubes with length-diameter ratios of 60 and 92 for a given range of conditions. The results indicate that, in the turbulent range of Reynolds number, a good correlation of the local heat-transfer coefficient is obtained when the physical properties and density of He are evaluated at the surface temperature. The average heat transfer coefficients are best correlated on the basis that the coefficient varies with a specific equation and that the physical properties and density are evaluated at the surface temperature. ***Maynard F. Taylor and Thomas A. Kirchgessner.*** *ARS Journal,* v. 30, Sept. 1960, p. 830 + 6 pages.

Transactions of the Society of Rheology. Presents symposia on mechanics of continua, and on adhesion and rheology. ***E. H. Lee, editor.*** v. IV. 368 pp. 1960. Interscience Publishers, New York. (QC189 So13t Vis.)

* **The Superposition of Forced and Free Convection at Low Flow Rates in a Vertical Tube.** The theory of combined free and forced laminar convection with simultaneous constant-flux heat and mass transfer in a vertical tube was experimentally verified by measurements of temperature distribution and heat exchange for water in a tube of 15 mm diameter. (*In German.*) Die Überlagerung von erzwungener und natürlicher Konvektion bei niedrigen Durchsätzen in einem lotrechten Rohr. ***William Greenwood Brown.*** *Forshung auf dem Gebiete des Ingenieurwesens* (Ausgabe B), v. 26; *VDI-Forschungsheft* 480, 1960, 31 pp.

Experiments on the Stability of Viscous Flow Between Rotating Cylinders. II. Visual Observations. Measurements of the hydrodynamic stability of viscous flow between rotating cylinders were made with an apparatus similar to that used by Taylor in his original experiments. The ratio of the radii of the cylinders was 1:2. The results confirm Chandrasekhar's theoretical calculations within experimental error. The asymptotic form of the stability relation when the cylinders rotate in opposite directions is derived and found to agree with experimental data at hand. ***R. J. Donnelly and D. Fultz.*** *Royal Society, Proceedings,* v. 258, ser. A, Oct. 4, 1960, p. 101-123 + 3 plates.

Finite Two-Dimensional Cavities. General formulae for generating unsteady potential flows characterized by the presence of a cavity (which can be finite in extent) are presented. The fluid at infinity is either in accelerative motion or at rest, but the two cases are essentially distinct. Steady flows in a gravitational field are also investigated, and a class of solutions representing such flows past a finite cavity is given. ***Chia-Shun Yih.*** *Royal Society, Proceedings,* v. 258, ser. A, Oct. 4, 1960, p. 90-100.

Instability of a Rotating Liquid Film With a Free Surface. Shows that instability occurs even for large values of the surface-tension parameter and at small Reynolds numbers. ***Chia-Shun Yih and J. F. C. Kingman.*** *Royal Society, Proceedings,* v. 258, ser. A, Oct. 4, 1960, p. 63-89 + 1 plate.

Viscosity-Concentration and Fluidity-Concentration Relationships for Suspensions of Spherical Particles in Newtonian Liquids. ***T. F. Ford.*** *Journal of Physical Chemistry,* v. 64, Sept. 1960, p. 1168-1174.

Rolling-Sphere Viscometer for Structured Liquids. Measurements are made on hitherto unsheared material, which are important in studying thixotropic or otherwise structured systems. Relative viscositites of glycerine-water mixtures and of fat-free milks determined in the sphere viscometer agree adequately with those from an Ostwald or other capillary viscometer; but the structure of renneted milk, even before rigidity sets in, is damaged by the drastic shearing and, for such systems, the rolling-sphere viscometer gives a more reliable picture of viscosity changes. ***G. W. Scott Blair and J. C. Oosthuizen.*** *British Journal of Applied Physics,* v. 11, Aug. 1960, p. 332-334.

The Viscosity of Superheated Steam up to 270°C. Describes a series of measurements of superheated steam obtained with the aid of an oscillating-disk viscometer. ***J. Kestin and H. E. Wang.*** *Physica*, v. 26, Aug. 1960, p. 575-584.

The Momentum Integral Equations for Three-Dimensional Laminar Boundary Layers in Incompressible Flow. *M. G. Hall.* *Australian Aeornautical Research Committee, Report ACA-62*, Nov. 1959, 28 pp. (TL529 Au78.1r Vis.)

The Flow of Fluids Through Channels With Porous Walls. Approximate solutions of the equations of motion governing laminar incompressible fluid flow through a cylindrical channel with a porous wall are derived. ***Francisco A. Guevara and William E. Wageman.*** *U. S. Atomic Energy Commission*, LA-2449, Sept. 23, 1960, 27 pp. (UF767 U3La Contin.)

* **The Flow of Gases Through High Polymer Films in Equilibrium With Sorbed Vapors. *Frank L. Pilar.*** *Journal of Polymer Science*, v. 45, July 1960, p. 205-215.

FOOD TECHNOLOGY

Effects of Sodium Metabisulphite, Antibiotics, and Gamma Irradiation on the Shelflife of Prepeeled Potatoes at Room Temperature. The combined use of low-dosage γ irradiation (300,000 or 100,000 rad) and oxytetracycline controlled bacterial development in prepeeled, packaged potatoes stored at room temperature for at least six days. However, color changes and the development of a "storage" off-flavor would preclude the use of this technique for commercial use. ***E. A. M. Asselbergs, W. E. Ferguson, W. P. Mohr, and K. F. MacQueen.*** *Applied Microbiology*, v. 8, no. 5, Sept. 1960, p. 311-314.

* **Changes in Hydration and Charges of Muscle Proteins, During Freeze-Dehydration of Meat.** Freeze-drying of beef results in a drop of water-holding capacity only in the isoelectric pH-range of muscle. It causes a tighter network of protein structure, probably because the peptide chains after drying lie more closely together. The undesirable changes in meat during freeze-drying are not due to the freezing process itself. ***Reiner Hamm and F. E. Deatherage.*** *Food Research*, v. 25, no. 5, Sept.-Oct. 1960, p. 573-586.

* **Changes in Hydration, Solubility and Charges of Muscle Proteins During Heating of Meat.** Between 30 and 40 C, a mild denaturation occurs on heating of beef. A strong denaturation starts at 40 C. By heating at temperatures >55 C, the negatively charged groups decrease again. ***Reiner Hamm and F. E. Deatherage.*** *Food Research*, v. 25, no. 5, Sept.-Oct. 1960, p. 587-610.

* **Histology and Histochemistry of Raw and Cooked Rice Kernels. *Ruby R. Little and Elsie H. Dawson.*** *Food Research*, v. 25, no. 5, Sept.-Oct. 1960, p. 611-622.

* **Influence of Freezing and Thawing on Hydration and Charges of the Muscle Proteins.** Quick-freezing and thawing of beef result in no considerable denaturation of muscle protein. Quick-freezing causes a very small but significant increase of the water-holding capacity of meat. Slow-freezing causes a significantly small decrease of the water-holding capacity of meat. ***F. E. Deatherage and Reiner Hamm.*** *Food Research*, v. 25, no. 5, Sept.-Oct. 1960, p. 623-629.

* **Biological Screening Techniques for Food Additives. *Margaret Ives and Edythe M. Nagler.*** *Food Technology*, v. 14, Oct. 1960, p. 499-502.

* **Nutritional and Chemical Changes Occurring in Heated Fats: A Review.** Observes that most of the available research data cannot be projected to predict whether an unsaturated oil will be damaged sufficiently during processing and commercial frying operations to be harmful. Data obtained is sufficient, however, to justify the suspicion that the use of such oils containing polymeric materials may not be desirable from a nutritional point of view. ***Edward G. Perkins.*** *Food Technology*, v. 14, Oct. 1960, p. 508-514.

* **Experimental Preservation of Poultry by Chlortetracycline and Radiation.** Ten ppm of chlortetracycline and 100,000 rads of ionizing radiation were used in an experimental antibiotic-radiation process for retarding microbial spoilage in prepackaged fresh chicken meat. Results obtained on meat independently treated with either radiation or antibiotic were inferior to those achieved with the combination process. ***A. W. Phillips, H. R. Newcomb, and F. C. Bach.*** *Food Technology*, v. 14, Oct. 1960, p. 521-522.

Radiation Technology in Food, Agriculture and Biology. *Norman W. Desrosier and Henry M. Rosenstock.* 401 pp. 1960. The AVI Publishing Co., Inc., Westport, Conn. (TX611 D47r)

Methods of Preserving Food Other Than Fermenting, Freezing or Canning. *F. C. Webb.* *Research Applied in Industry*, v. 13, Oct. 1960, p. 378-382.

FUELS AND COMBUSTION

* **Characteristics of the Hydrocarbon Constituents of Coals.** A study of metamorphic series of Donbass coals, from long-flame to semianthracite types, by their successive extraction with chloroform, alcohol benzene, and naphthalene. The isometamorphic vapors of coals contained in the Donbass, of two genetic types, were examined, the two varieties being formed under more or less regenerating conditions. The problem of the hydrocarbon composition of these coals was examined. (*In Russian.*) O kharakteristike uglevodorodynkh komponentov kamennykh ugleĭ. ***N. G. Kim and O. A. Radchenko.*** *Akademiia Nauk SSSR, Otdelenie Tekhnicheskikh Nauk, Izvestiia, Metallurgiia i Toplivo*, 1960, no. 4, July-Aug., p. 168-174.

Thermodynamic Properties of the Combustion Products of Graphite and Oxygen in Idealized Dust Flames. *Robert W. Smith, Jr., Edwin B. Cook, and Hans M. Cassel.* *U. S. Bureau of Mines Report of Investigations* 5668, 1960, 12 pp. (TN21 Un3r Room 290)

Composition of a Shale-Oil Naphtha. The composition computed from analyses of 105 narrow-boiling distillation fractions. ***H. H. Heady, L. G. Adams, and G. U. Dinneen.*** *U. S. Bureau of Mines Report of Investigations* 5662, 1960, 12 pp. (TN21 Un3r Room 290)

Minimum Ignition-Energy Concept and Its Application to Safety Engineering. Surveys the present status and usefulness of the minimum ignition-energy concept, and the recent data that are believed to bear on the safety problem associated with the ignition of combustible gases by electric discharges. ***E. L. Litchfield.*** *U. S. Bureau of Mines Report of Investigations* 5671, 1960, 10 pp. (TN21 Un3r Room 290)

The Russian Literature on Rocket Propellants. Examination of the Russian literature reveals a thorough familiarity with Western developments, and considerable research activity on both solid and liquid propellants of the conventional and nonconventional variety. ***F. J. Krieger.*** *Rand Corporation, Report* P-1954, Mar. 25, 1960, 22 pp. (T13 R15r Contin.)

* **The Dependence of the Lower Concentration Limits of Inflammation of Gas-Air Mixtures Upon the Molecular Structure of the Combustible Component.** A quantitative expression correlating the lower inflammation limits of gas/vapor-air mixtures and the C atom content of the flammable molecule has been proposed within the limits of the homologous series of organic molecules on the basis of Semenov's heat-explosion theory. The wide applicability of the expression has been demonstrated with the aid of the comparative methods of calculating properties of substances systematized by M. Karapet'yants. (*In Russian.*) Zavisimost' nizhnikh kontsentratsionnykh predelov vosplameniia gazovozdushnykh smeseĭ ot molekuliarnoĭ struktury goriuchego komponenta. ***N. V. Solov'ev and A. N. Baratov.*** *Zhurnal Fizicheskoĭ Khimii*, v. 34, no. 8, Aug. 1960, p. 1661-1670.

How to Blend for Volatility. Hot weather problems; cold weather problems; non-seasonal problems; goals for volatility blending; how to predict gasoline blends. ***George H. Unzelman and Eugene J. Forster.*** *Petroleum Refiner*, v. 39, Oct. 1960, p. 109-140.

Heat Diffusion in Gases, Including Effects of Chemical Reaction. The diffusivity is taken proportional to the integral of thermal conductivity, where the gas is ideal, and is considered constant over the temperature interval in which a chemical reaction occurs. The heat diffusion equation is then solved numerically for a semi-infinite gas medium with constant initial and boundary conditions. ***C. Frederick Hansen.*** *ARS Journal*, v. 30, Oct. 1960, p. 942-946.

Solid Propellant Detonability. Conventional double-base propellants have a sensitivity somewhat less than that of conventional insensitive military explosives. This sensitivity increases slightly with an increase in temperature and markedly with decreasing density. Pore type is important; samples with nonconnected pores increase in sensitivity as temperature decreases. Many composite propellants containing conventional rubber-like binders are not easily detonated. ***Adolph B. Amster, Evan C. Noonan, and George J. Bryan.*** *ARS Journal*, v. 30, Oct. 1960, p. 960-964.

* **An Investigation of Compression Waves Formed During the Burning of Gaseous Mixtures.** During the heating of methane-oxygen mixtures in pipes open at one end, compression waves arise and increase within the range of the methane change in the mixtures between 7.5 and 53%. If the methane content is lowered from 9.1 to 6.7%, first there is a rapid decrease of the maximum amplitude of the compression wave; with further decrease of the methane content, the increase in the heating process of the initial compression wave ceases completely. (*In Russian.*) Issledovanie voln szhatiia pri gorenii gazovykh smesei. ***S. M. Kogarko and A. S. Novikov.*** *Akademiia Nauk SSSR, Doklady*, v. 134, no. 1, Sept. 1960, p. 125-127.

* **Evaporation of Stationary Droplets in High Temperature Surroundings.** ***T. W. Hoffman and W. H. Gauvin.*** *Canadian Journal of Chemical Engineering*, v. 38, no. 5, Oct. 1960, p. 129-137.

* **Experimental Boiler for Fuel Oil Combustion Research.** ***K. J. Mackenzie, W. O. A. Morton, G. F. J. Murray, and W. V. P. Ferguson.*** *Engineer*, v. 210, Sept. 30, 1960, p. 548-551.

* **Fuel Oil Stability.** Stability problem of fuel oil is reviewed with special reference to the occurrence of sludge, due to insufficient peptization of asphaltenes in the continuous phase. (*In Swedish.*) Eldningsoljors stabilitet. ***Peter Tourbier.*** *Svensk Kemisk Tidskrift*, v. 72, no. 8, 1960, p. 516-526.

* **Recent Advances in Aircraft Fuels.** Discusses recent specification changes for aviation gasolines and outlines the evolution of military specifications for aircraft turbine fuels. ***R. G. Davies.*** *Canadian Aeronautical Journal*, v. 6, no. 8, Oct. 1960, p. 320-330.

Outlook: Coal vs. Oil. Describes some of the hottest current competitive clashes. ***W. A. Raleigh, Jr.*** *Coal Age*, v. 65, Oct. 1960, p. 72-75.

Ultra-Hot "Plasmas" May Yield New Technologies. Plasma technology in extractive metallurgy; points to some ways in which the metallurgist may put it to use. ***Paul M. Tyler.*** *Engineering and Mining Journal*, v. 161, Oct. 1960, p. 112-114.

The Fischer-Tropsch Synthesis Using Gas Recycle Cooling. At an hourly space velocity of 1100, the feed gas, a mixture of 1.5 parts H to one of CO, was converted 90%, producing hydrocarbons predominantly in the gasoline range. ***D. Bienstock, R. M. Jimeson, J. H. Field, and H. E. Benson.*** *U. S. Bureau of Mines Report of Investigations* 5655, 1960, 25 pp. (TN21 Un3r Room 290)

* **The Determination of SO_2, SO_3 and H_2S in Combustion Gases.** With the direct method, a 20% solution of NaOH containing formaldehyde, is used for the gas absorption. With the difference method, a starch/iodide solution and a $n/2$ NaOH soln. is used. The direct method produces better results. Hydrogen sulfide is determined through the preliminary use of an acetic acid-cadmium acetate solution containing formaldehyde. (*In German.*) Die Bestimmung von SO_2, SO_3 und H_2S in Feuerungsgasen. ***K. Wickert.*** *Brennstoff-Wärme-Kraft*, v. 12, Oct. 1960, p. 449-451.

Solids Competitive for Multi-Million-Pound Boosters. Shows how solid rocket designers expect to attain thrusts of a million pounds and more. ***John Gustavson.*** *Space/Aeronautics*, v. 34, no. 4, Oct. 1960, p. 158-160.

Producing Heavy Fuel Oil by Hydrogenating Bituminous Coal. ***Henry H. Ginsberg, Paul S. Lewis, Robert B. Anderson, and Raymond W. Hiteshue.*** *U. S. Bureau of Mines Report of Investigations* 5674, 1960, 57 pp. (TN21 Un3r Room 290)

* **Heterogeneous Combustion of Multicomponent Fuels.** Variation of burning-rate coefficient (the time-rate of change of drop cross-sectional area) as a function of composition was determined for single drops of fuel mixtures. Results indicate that during combustion the composition of a multicomponent fuel drop changes by a process of simple batch distillation. ***B. J. Wood, H. Wise, and S. H. Inami.*** *Combustion and Flame*, v. 4, no. 3, Sept. 1960, p. 235-242.

* **The Propagation of the Deflagrations in Gaseous Combustible Mixtures at Pressures Equal to or Lower Than the Atmospheric Pressure.** With a vertical tube the flame front has the symmetry of revolution round the tube axis at pressures below a certain critical pressure, which depends on the nature of the mixture, the diameter of the tube, and the direction in which the flame is propagated. Very clear-cut photographs were taken of the flame front profiles with a specially designed camera, and their areas were accurately calculated. The influence of the pressure on the normal flame velocity were measured in the case of highly diversified mixtures, quite apart from the wall effect. (*In French.*) La propagation des déflagrations dans les mélanges combustibles gazeux aux pressions égales ou inférieures a la pression atmosphérique. ***J. Combourieu.*** *Institut Français du Pétrole, Revue et Annales des Combustibles Liquides*, v. 15, July-Aug. 1960, p. 1-64.

* **Chlorine Inhibition of Carbon Monoxide Flames.** Measurements of the reduction by Cl over a wide range of CO—air compositions show that the relative change with an increment of Cl is, at most, only weakly dependent upon the CO-air ratio or upon the H content. ***H. B. Palmer and D. J. Seery.*** *Combustion and Flame*, v. 4, no. 3, Sept. 1960, p. 213-221.

* **Mechanisms of Coal Pyrolysis. III. Variation of the Magnetic Mass Susceptibility and Some Related Parameters With Carbonization Temperature.** ***Patricia A. Cavell and N. Berkowitz.*** *Fuel*, v. 39, no. 5, Sept. 1960, p. 401-412.

* **A New Process for Briquetting Coal Without a Binder.** Research and development associated with a process for the binderless briquetting of bituminous coal; a new process which does not demand the extremely fine grinding or the very high pressure which were the downfall of earlier attempts. ***H. R. Gregory.*** *Institute of Fuel, Journal*, v. 33, Sept. 1960, p. 447-461 + 5 plates.

Occurrence of Surface Ignition Depends on: Surface Temperature, Local Air-Fuel Ratio. ***F. W. Bowditch and T. C. Yu.*** *SAE Journal*, v. 68, Oct. 1960, p. 58-61.

GEOLOGY, GEOPHYSICS, MINERALOGY, AND MINING ENGINEERING

* **Stability of Water Oil Contact in Stratified Porous Media.** The process of oil displacement by water from stratified porous media on transparent models of two- or three-layer seams was investigated. In such media, even with a substantial difference in the transparency of the layers, there is a leveling of the shape of the surface of the water-oil contact. Beaten glass with a hydrophilic surface, non-polar kerosene of 1.3 sp viscosity and distilled water of 1 sp viscosity were used as models. (*In Russian.*) Ob ustoĭchivosti vodo-neftianogo kontakta v sloistykh poristykh sredakh. ***V. G. Ogandzhaniants and I. I. Egorova.*** *Akademiia Nauk SSSR, Doklady*, v. 134, no. 1, Sept. 1960, p. 59-61.

* **The Distribution of Chemical Elements in Clayey Minerals.** This distribution depends on the physico-chemical properties of the element, on the conditions of formation of the

mineral, on the composition of the gangues, and on the intensity of the chemical weathering. In minerals of continental and maritime deposits, these differences can be considerable as regards couples of elements. A study of minor elements in clays and clayey minerals in different fractions explains the problem of the migration of elements and the formation of the deposition of some of them in sedimentary strata. (*In Russian.*) Raspredelenie khimicheskikh elementov v glinistykh mineralakh. **S. M. Katchenkov.** *Akademiia Nauk SSSR, Doklady*, v. 134, no. 3, Sept. 1960, p. 680-683.

* **Petroleum Resources in Basement Rocks.** All known basement rock accumulations occur where the basement rock is at a higher elevation than the surrounding flanking sediments. Most basement rock petroleum deposits have been found by accident; the probable reserve in these rocks is of such magnitude that discovery by design should become the rule. **Kenneth K. Landes, et al.** *American Association of Petroleum Geologists, Bulletin*, v. 44, Oct. 1960, p. 1682-1691.

* **Organic Matter in Marine Sediments Off East Coast of India. M. Subba Rao.** *American Association of Petroleum Geologists, Bulletin*, v. 44, Oct. 1960, p. 1705-1713.

* **Some Observations With a Hammer Refraction Seismograph.** Accuracy was found to decrease from about ± 10% to depths of 75 ft to about ± 15% below 100 ft. **George D. Hobson and L. S. Collett.** *Canadian Mining and Metallurgical Bulletin*, v. 53, no. 581, Sept. 1960, p. 674-681; *Canadian Institute of Mining and Metallurgy, Transactions*, v. 63, 1960, p. 448-455.

Special Equipment, Three-Step Preparation Mark Two-Seam Stripping at Vogue Mine. Alfred E. Flowers. *Coal Age*, v. 65, Oct. 1960, p. 76-82.

* **Concerning the Circulation and the Water Masses in the North-Eastern Part of the Coral Sea.** Investigation of the waters occupying 1,000 meters of the sea surface, the geostrophical displacement of these waters and their fluctuations during a year. Reveals the existence in the austral summer of a "contra solem" vortex centered about 15° S and 165° E. This vortex is responsible for the orientation of the displacements directed southward near the New Hebrides and northward along New Caledonia. (*In French.*) Sur la circulation et les masses d'eau dans le Nord-Est de la mer de Corail. **Henri Rotschi.** *Comptes Rendus Hebdomaires des Séances de l'Académie des Sciences*, v. 251, no. 7, Aug. 17, 1960, p. 965-967.

* **Recent Developments in Geophysics.** Earth's resonance gives clues to internal structure. **Angela Croome.** *Discovery*, v. 21, Oct. 1960, p. 444-447.

Oxidation of Sulfide Ore Bodies. II. Oxidation Mechanisms of Sulfide Minerals at 25° C. Motoaki Sato. *Economic Geology*, v. 55, no. 6, Sept.-Oct. 1960, p. 1202-1231.

* **The Novo Urei Meteorite.** The occurrence of diamond in Novo Urei has been confirmed by X-ray diffraction. **A. E. Ringwood.** *Geochimica et Cosmochimica Acta*, v. 20, no. 1, Sept. 1960, p. 1-4 + 1 plate.

* **Cosmogenic Nuclear Reactions in Iron Meteorites.** The cosmogenic He^3, He^4, Ne^{21}, Ne^{22}, Ar^{36}, and Ar^{38} isotopes were measured mass spectrometrically in seven ataxites and one octahedrite. Exposure ages are deduced on the basis of ratios, total isotopic abundances, and previously measured Cl^{36} values. **D. E. Fisher and O. A. Schaeffer.** *Geochimica et Cosmochimica Acta*, v. 20, no. 1, Sept. 1960, p. 5-14.

Hydrodynamics of Oceans and Atmospheres. The perturbation equations; steady motions; field equations; earth's atmosphere, oceans and lakes; isothermal atmosphere; plane level surfaces without rotation; the thermocline; the wave equation for a spherical surface. **Carl Eckart.** 290 pp. 1960. Pergamon Press, New York. (QA911 Ec53h)

* **Study of the Spontaneous Displacement of a Liquid by Another in a Porous Medium. (Inhibition)** In the medium mentioned, oil was displaced by water. These experiments are fundamental and will enable other experiments to be made for determining the influence of various parameters entering in this type of displacement; they have proved the efficiency of a method of experiment; finally, they have shown the primary importance of wettability and led to the study of a method for

measuring this parameter. (*In French.*) Étude du déplacement spontané d'un fluide par un autre dans un milieu poreux. (Imbibition) **M. Lanchon.** *Institut Français du Pétrole, Revue et Annales des Combustibles Liquides*, v. 15, Sept. 1960, p. 1294-1346.

* **Natural Radiocarbon in the Atlantic Ocean.** Natural radiocarbon concentration in the dissolved bicarbonate of 135 samples representing the major water masses of the Atlantic Ocean was determined with the precision ranging from 0.5 to 1.3%. **Wallace S. Broecker, Robert Gerard, Maurice Ewing, and Bruce C. Heezen.** *Journal of Geophysical Research*, v. 65, no. 9, Sept. 1960, p. 2903-2931.

* **The Origin of Meteorites.** Suggests that meteorites are not fragments of other bodies, such as planets, but have always been independent and individual objects. **Brian Mason.** *Journal of Geophysical Research*, v. 65, no. 9, Sept. 1960, p. 2965-2970.

* **Electrical Resistivity of Frozen Earth. T. Hatherton.** *Journal of Geophysical Research*, v. 65, no. 9, Sept. 1960, p. 3023-3024.

Non-Steady-State Fluid Flow and Diffusion in Porous Media Containing Dead-End Pore Volume. A system of equations is derived that describes pressure transients during non-steady-state flow of a fluid through a linear porous medium which contains dead-end pore volume. Analogous equations are shown to describe non-steady-state diffusion through fluid contained in such porous media. The theoretical and experimental results are in excellent agreement, thereby establishing the validity of the equations. **Richard C. Goodknight, Waldemar A. Klikoff, Jr., and Irving Fatt.** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1162-1168.

* **Jet Piercing for Hard Rock Formations.** Description of the jet piercing process and equipment, together with information on its performance at various locations for the production of blastholes. **L. Walter.** *Mine & Quarry Engineering*, v. 26, Oct. 1960, p. 440-445.

* **Gold Forms in Ores.** Discusses various types of Au ores and shows photomicrographs of the general forms the Au assumes in the ore. **A. J. Weinig.** *Mines Magaizne*, v. 50, Oct. 1960, p. 27-32.

* **Sonar Exploration of Coal Mine Roof Strata.** Theory and actual experiments indicate the practicability of using sonar techniques to detect hidden nonconformities in coal mine roof. **Charles E. Mongan, Jr. and Thomas C. Miller.** *Mining Congress Journal*, v. 46, Oct. 1960, p. 35-39.

* **Mineral Resources on the Ocean Floor.** Discusses the distribution and recovery of Mn nodules from the ocean floor. **John L. Mero.** *Mining Congress Journal*, v. 46, Oct. 1960, p. 48-53.

Controlling Fires in Mines With High-Expansion Foam. Experiments conducted by the USBM show the potential value of the foam-plug method for fighting fires in either coal or metal mines. **John Nagy, Edwin M. Murphy, and Donald W. Mitchell.** *Mining Engineering*, v. 12, Sept. 1960, p. 993-996.

Stripping Overburden With a Dredge. Applies to development of a bauxite deposit below sea level. **John G. Cazort, Jr.** *Mining Engineering*, v. 12, Oct. 1960, p. 1083-1089.

Puzzler: The 'Atmosphere' of Space. Study at Ohio State underlines dearth of data on how the space environment will treat materials; simulation is extremely difficult. *Missiles and Rockets*, v. 7, no. 15, Oct. 10, 1960, p. 36-37.

The Sun's Influence on Earth and Space. Lloyd V. Berkner. *New Scientist*, v. 8, Sept. 15, 1960, p. 713-714.

How Gulf Set a New Drilling Record. Pictorial story of how a drilling crew trimmed time from drilling record in Timbalier Bay, La. **Carl Hoot.** *Oil and Gas Journal*, v. 58, no. 42, Oct. 17, 1960, p. 92-99.

New Mud Organic—A Different Approach to Reducing Drilling Costs. R. A. Jung. *Oil and Gas Journal*, v. 58, no. 43, Oct. 24, 1960, p. 129 + 2 pages.

* **Air Motor Drill.** Field tests show increased penetration rate and straighter hole with this new drilling tool. **H. J. Magner.** *Petroleum Engineer*, v. 32, Oct. 1960, p. B46 + 2 pages.

*** Gasometry of Wells and Its Prospecting Importance.** ***B. L. Yasenev.*** *Petroleum Geology*, v. 3, no. 2B, 1959, p. 105-108.

A 75 cm Receiver for Radio Astronomy and Some Observational Results. Radio-astronomical observations are described that have been made with the 25 m parabolic reflector of the Radio Observatory at Dwingeloo. A large isophot of the sky is included. ***C. L. Seeger, F. L. H. M. Stumpers, and N. van Hurck.*** *Philips Technical Review*, v. 21, no. 11, Sept. 1960, p. 317-333.

*** Vermiculite Sparkles in Modern Industry.** Production booms in South Carolina for this rare nonmetallic mineral. ***Oliver S. North.*** *Rock Products*, v. 63, Oct. 1960, p. 94-98.

How Volcanoes Grow. Geology, geochemistry, and geophysics disclose the constitution and eruption mechanism of Hawaiian volcanoes. ***J. P. Eaton and K. J. Murata.*** *Science*, v. 132, Oct. 7, 1960, p. 925-938.

*** Drillability and Blasting Resistance of Rocks.** Results of some experiments on the mechanical and geological properties of rocks. A set of parameters was established which make it possible to determine the drillability and resistance to blasting of rocks by laboratory methods. These methods are all known, except one, which was developed to determine the wearing properties of rocks on tungsten carbide. It is expected that the parameters and laboratory methods adopted will facilitate accurate forecasts of these properties. (*In Norwegian.*) Bergartenes borbarhet og sprengbarhet. ***Rolf Selmer-Olsen and Reidar Lien.*** *Teknisk Ukeblad*, v. 107, no. 34, Sept. 22, 1960, p. 753-761.

*** Laws of Geochemical Distribution.** Principles governing the distribution of elements between minerals, and the sequence of entry of elements into crystallizing minerals are discussed. Of fundamental importance are crystal structure, chemical bonding, ionic radii, ionic charge, ionization potential and/or electronegativity, and temperature. For magmatic minerals, Goldschmidt's rules of camouflage, admission, and capture serve to explain the behavior of low-charged cations with noble gas electron configuration, but breaks down when these ions are compared with ions having other electron configurations. (*In Norwegian.*) Geokjemiske fordelingslover. ***Knut S. Heier.*** *Tidsskrift for Kjemi, Bergvesen og Metallurgi*, v. 20, no. 7, Sept. 1960, p. 176-183.

Underground Gasification of Coal. Hydraulic fracturing as method of preparing a coalbed. ***J. P. Capp, et al.*** *U. S. Bureau of Mines Report of Investigations* 5666, 1960, 50 pp. (TN21 Un3r Room 290)

*** On the Design of Aseismic Earth Dams.** To avoid dangerous resonance phenomena in earth dams, one has to know the frequency distribution of the earth shock and the natural periods of vibration of the construction subject to such shocks. (*In German.*) Über die Berechnung von erdbebensicheren Erddämmen. ***N. N. Ambraseys.*** *VDI Zeitschrift*, v. 102, no. 26, Sept. 11, 1960, p. 1241-1243.

*** Level of Development of Mechanized Underground Coal Mining.** Up to the end of 1959 the proportion of West German hard coal mines equipped with fully or partly mechanized mining machinery increased to about 50%, compared with 37.4% at the end of 1956. Of this 50%, almost three-fifths (representing 28.7% of the total quantity of coal mined) is accounted for by fully mechanized workings. (*In German.*) Stand der mechanisierten Kohlengewinnung unter Tage. ***Heinrich Kuhlmann.*** *VDI Zeitschrift*, v. 102, no. 28, Oct. 1960, p. 1311-1316.

*** The Active Method in Studying the Central Arctic.** Since 1945, on drifting stations near the North Pole, daily information has been collected concerning the characteristic state of the waters and ices, rocks, high layers of the atmosphere, climate, and magnetic conditions. The complex character of the investigations, branches of science, personnel, methods, new equipment, and hours involved are reported. (*In Russian.*) Aktivnyĭ metod izucheniia prirody Tsentral'noĭ Arktiki. ***P. A. Gordienko.*** *Vsesoiuznoe Geograficheskoe Obshchestvo, Izvestiia*, v. 92, no. 4, July-Aug. 1960, p. 293-307.

GRAPHIC ARTS

a **An Electron Spin Resonance Investigation of Photographic Processes in Crystals of AgCl Containing Traces of CuCl.** An electron spin resonance spectrum, due to the formation of cupric ions during illumination, was observed in crystals of silver chloride containing 0·1 mol% of cuprous chloride, which were quenched to −183 C immediately following irradiation. The spectrum fades rapidly if the crystals are kept at any temperature above −140 C after the end of illumination. ***I. S. Ciccarello, M. B. Palma-Vittorelli, and M. U. Palma.*** *Phiolosophical Magaizne*, v. 5, ser. 8, July 1960, p. 723-727.

b *** A Study of the Tone Reproduction Obtained on Prints Produced From Powderless Etched Plates.** A series of experiments designed to give information concerning the changes in dot size that occur in letterpress printing during the sequence negative-powderless etched plate—final print on paper, are described. Graphs showing the relation between the percentage printing area on the plate and the percentage printing area on the negative are given. The graphs obtained by plotting the optical densities of the prints against the optical densities of the negatives in the case of letterpress and lithographic printing are compared. ***S. D. Winn.*** *Journal of Photographic Science*, v. 8, no. 5, Sept.-Oct. 1960, p. 173-177.

c *** A High Speed Colour Printer.** A high-speed printer for making color paper prints from color photographic negatives has been engineered and constructed by Technicolor Corporation. Salient features of the printer are: automatic operation; two printing beams; high production rate; precoding of negatives; stable operation. Special design features to attain fast, stable operation are incorporated. ***A. M. Gundelfinger, E. A. Taylor, and R. W. Yancey.*** *Journal of Photographic Science*, v. 8, no. 5, Sept.-Oct. 1960, p. 161-170.

d *** Satellite Photography With Strip and Frame Cameras.** The problems associated with satellites as camera carrying vehicles are quite different from those of conventional aircraft. Discusses the use of strip cameras and frame cameras in satellite operations. The desirable and undesirable characteristics of each camera type are discussed and compared. It is shown that both cameras will have a place in future satellites depending upon the purpose of the photography. ***Donn L. Ockert.*** *Photogrammetric Engineering*, v. 26, no. 4, Sept. 1960, p. 592-596.

e *** New Photogrammetric Support Equipment.** During the past year, ACIC has been investigating various equipment which can be used as support in photogrammetric compilation. The results of the investigation into four items of equipment are presented. ***Kenneth T. Sime.*** *Photogrammetric Engineering*, v. 26, no. 4, Sept. 1960, p. 574-579.

f *** Eye-Movement Camera Redesign Eliminates Parallax.** Redesign is smaller, lighter, parallax-free and has lower center of gravity. Special motion-picture camera is "U" shaped with film spools located far back on either side of head for better balance. Film drive motor is located at front of helmet and drives film gate directly. Camera holds 125 ft of single 8-mm film, providing running time of 20 min. at eight frames per sec. ***E. J. Stefanides.*** *Design News*, v. 15, Oct. 10, 1960, p. 28-29.

g *** The Influence of Some Addition Agents on the Rate of Development of Liquid Photographic Emulsion.** The effect of some heterocyclic thiones and other addition agents on the rate of development of silver chloride liquid emulsion by a dilute Phenidone-hydroquinone developer was examined. A correlation was observed between the blue-black toning effect of the heterocyclic thiones and the acceleration of development by these agents. N-dodecylpyridinium salt, however, accelerates development but does not have a blue-black toning effect, and some derivatives of benzimidazole and 5-methyl-7-hydroxy-1,3,4-triazaindolizine have a blue-black toning effect but retard or have little effect on the rate of development. ***K. Futaki and Y. Ohyama.*** *Photographic Science and Engineering*, v. 4, no. 5, Sept.-Oct. 1960, p. 257-263.

h *** The Effect of Gamma-Ray Exposure on Camera Films.** A γ-ray fog tends to reduce the effective contrast and speed of a photographic material and to increase the graininess. The consequences of the first two effects can be minimized by proper

choice of printing-paper grade and by increasing camera exposure, with the result that the increase of graininess may be the limiting factor. A film for use in the presence of γ rays should have as low a speed as lens and exposure-time requirements will permit. Additional desirable features are: a high ratio of light to γ-ray sensitivity, a high contrast, and a long density range over which the useful gradient is maintained. ***G. M. Corney.*** *Photographic Science and Engineering*, v. 4, no. 5, Sept.-Oct. 1960, p. 291-295.

Films for Machine Read-Out. For more than a century photographic films were designed for the approval of the human eye. With the development of electronic computers ("machine-brains"), there has come about a new use for films in machine read-out. Therefore, films must be designed to meet the "approval" of the light-sensitive cell as well as of the human eye. In making films for these new applications, a new engineering approach is required. ***Harry P. Brueggemann.*** *Society of Motion Picture and Television Engineers, Journal*, v. 69, Sept. 1960, p. 602-603.

High Vacuum High Temperature X-Ray Camera. Describes a camera suitable for the examination of reactive metals such as Ti and Zr up to temperatures of 1000 C in a vacuum better than 1×10^{-6} mm of Hg. The high vacuum is obtained by constructing the camera in glass without demountable seals, and the use of a radiant heater in place of a conventional furnace assembly. ***B. A. Hatt, P.J.C. Kent, and G. I. Williams.*** *Journal of Scientific Instruments*, v. 37, Aug. 1960, p. 273-276.

HEAT POWER

*** Two-Cycle Gas Engine Driven Centrifugal Compressor in Natural Gas Transmission.** ***Corder Reynolds and John Murphy.*** *Gas Age*, v. 126, Oct. 13, 1960, p. 45-47.

Concerning the Analogy Between Combustion in a Detonation Wave and in a Rocket Engine. An aerothermodynamic analysis of the over-all combustion process in a rocket engine shows that the deflagration branch of the Hugoniot curve can be considered as the geometric locus of points, each of which corresponds uniquely to a definite rate of heat evaluation (called herein "forcing" of the combustion mode) in the jet engine chamber. Shows that this process is unstable in a high output chamber, and a criterion of the instability is derived. The combustion instability at a definite degree of "forcing" leads to resonant high-frequency pressure oscillations in the chamber. The instability of the combustion front in a detonation wave, where high-frequency pulsations were experimentally observed, is characterized by the same criterion. It was experimentally established that the oblique shocks play a decisive role in the mechanism of the high-frequency oscillations in the case of pulsating and spining detonations, and that in this case there is no plane wave front. Suggests that the pulsation mechanism in detonation is analogous to the vibration mechanism in the combustion in jet engine chambers. ***Yu. N. Denisov, Ya. K. Trashin, and K. I. Shchelkin.*** *ARS Journal*, v. 30, Sept. 1960, p. 834-840. (From *Izvestiia Akademii Nauk SSSR, Otdelenie Tekhnicheskikh Nauk, Energetika i Avtomatika*, no. 6, 1959, p. 79-89).

Heat Storage System for Satellite Powerplants. A system was designed for storing energy as heat, making use of the high heat of fusion of lithium hydride. This heat storage system, for use specifically with heat engines or thermoelectric energy conversion systems, will potentially store enough energy to supply up to 75 w-hr of usable electrical power per pound of storage system weight. ***C. L. Walker, J. D. Matchett, and R. J. Hanold.*** *ARS Journal*, v. 30, Oct. 1960, p. 979-980.

Solar Turbo Power Plant Design. Discusses the design of a lunar-based power plant powered entirely by solar radiation. ***D. B. Mackay and E. L. Leventhal.*** *ASME, Transactions, Series A, Journal of Engineering for Power*, v. 82, no. 4, Oct. 1960, p. 315-324.

Analysis of Solar-Furnace Performance in Mechanical Testing at Extremely High Temperatures. ***G. S. Leon and M. E. Shank.*** *ASME, Transactions, Series A, Journal of Engineering for Power*, v. 82, no. 4, Oct. 1960, p. 325-332.

a • *** The Allison T63 Gas Turbine Engine.** Answers the Army's need for a powerful but lightweight gas-turbine power plant for fixed wing aircraft and light utility helicopters. ***James E. Knott.*** *American Helicopter Society, Newsletter*, v. 6, Sept. 1960, p. 2-6.

b • *** Silicon Photocells to Utilise Solar Energy.** In quantities, power could be produced for about \$5/Kwh but, at present, the cell's first costs and also the added cost of storage batteries, which are usually needed, are its chief limitations. ***C. A. Escoffery and W. Luft.*** *Automation Progress*, v. 5, Oct. 1960, p. 332-336.

c • *** Secondary Power Systems for Space Vehicles.** Comparison of the various systems discussed from the viewpoint of weight. Performance figures for some of the systems are based on calculations rather than on performance and are therefore dependent upon future developments. ***D. E. Whyte.*** *Canadian Aeronautical Journal*, v. 6, no. 8, Oct. 1960, p. 331-336.

d • *** Electric Power by Unconventional Methods of Energy Conversion.** Methods for direct conversion of energy into electricity assume new importance as possibilities for power generation on a substantial scale are further explored. ***P. E. Benner, A. G. Mellor, and J. B. McClure.*** *Electric Light and Power*, v. 38, no. 20, Oct. 15, 1960, p. 60 + 7 pages.

• **The Role of Industry in Energy-Conversion Research.** Concerns the role of fuel cells, thermoelectricity, thermionics, and magneto-hydrodynamics in the face of diminishing fossil fuel resources. ***S. W. Herwald.*** *Electrical Engineering*, v. 79, Sept. 1960, p. 741-743.

e • *** Mathematical Theory of a Peltier Refrigerator and of a Thermoelectric Generator.** An equation was derived from fundamental principles of thermodynamics and heat transfer, where three coefficients are ratios that connect four heat-power terms. Here heat power transferred to or from the environment was considered as well as the Peltier, Fourier, Thomson, and Joule heat powers. Particular solutions were obtained that show the temperature distribution along the thermocouple arms. From the primary equation, one of the solutions, many others were developed which are useful in designing Peltier refrigerators and thermoelectric generators and to determine their operating performances. (*In French.*) Théorie mathématique d'un réfrigérateur a effet Peltier et d'un générateur thermo-électrique. ***E. B. Penrod and Cho Yen Ho.*** *Journal de Physique et le Radium*, (Suppl.), v. 21, no. 7, July 1960, p. 97A-112A.

f • *** Enhancing the Potentialities of the Automotive Gas Turbine.** Methods of improving efficiency and possible future trends. ***H. F. Jones.*** *Oil Engine and Gas Turbine*, v. 28, Oct. 1960, p. 228-229.

g • **Shell's Low Temperature Fuel Cell.** Announces that the cell generates from three to five times more power per unit volume than other similar cells under development. *Petroleum*, v. 23, Oct. 1960, p. 391.

h • **Plasma Engine Holds Great Promise for Space Travel.** ***S. W. Kash.*** *SAE Journal*, v. 68, Oct. 1960, p. 50-52.

i • *** Efficiency of Closed Gas Turbines as a Function of the Density and Specific Heat of the Operating Gas.** Makes an analysis of the nature of internal losses in closed gas turbines and gives some formulas which allow calculation of the internal efficiency. (*In Italian.*) Il rendimento delle turbine a ciclo chiuso in funzione della densità e del calore specifico del gas operante. ***Sabino Roccotelli.*** *Tecnica Italiana*, v. 25, no. 5, July-Aug. 1960, p. 333-339.

j • *** Investigation of the Combustion and Cooling Process of a Diesel Engine in High Speed Operation.** The analysis concerns a swirl chamber diesel engine on the basis of indicator and entropy diagrams. The integral curves for heat transfer from the burning oil and for the cooling effect are derived from the entropy diagram. The heat and cooling intensity are derived from the integral curves. The visible and invisible and thus the total after-burning are determined. (*In Norwegian.*) Undersøkelse av forbrennings- og kjøleprosessen ved hurtiggående dieselmotorer. ***Ivar B. Stokke.*** *Teknisk Ukeblad*, v. 107, no. 33, Sept. 15, 1960, p. 733-738.

k •

Performance of Several Method-of-Characteristics Exhaust Nozzles. Nozzle performance data were obtained with three "method-of-characteristics" nozzles and a 15° conical nozzle at pressure ratios up to 130. Each basic configuration was cut off and tested at expansion ratios of 25, 20, 15, and 10. Theoretical and measured nozzle momentum coefficients agreed within about 0.6 per cent. ***John M. Farley and Carl E. Campbell.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN*-D-293, Oct. 1960, 33 pp. (TL570 Un3t Vis.)

Gas Turbine Applications in Industry. Inherent advantages in certain processes, coupled with competitive installation and operating costs, are establishing an important position for gas turbines in industry. ***D. F. Bruce.*** *Westinghouse Engineer,* v. 20, no. 6, Nov. 1960, p. 188-192.

HUMAN ENGINEERING

* **The Perception of a Depth Interval With Binocular Disparity Cues.** Applies a previously developed hypothesis to the problem of the perceptual duplication of a depth interval at different distances from *O* using binocular disparity cues. ***Walter C. Gogel.*** *Journal of Psychology,* v. 50, Oct. 1960, p. 257-269.

* **The Determination of Perceived Movement Direction.** Explores the role of directional connotation in the perception of arrows and arrow-like figures. Asks the question: How much like an arrow does an arrow have to look before its "arrowness" becomes an effective determinant of perceived movement direction? ***Martin Krampen and Hans H. Toch.*** *Journal of Psychology,* v. 50, Oct. 1960, p. 271-278.

INFORMATION—PREPARATION AND DISSEMINATION

AIP Documentation Research Project. A progress report on American Institute of Physics Documentation Research Project which began in 1958. Having identified the problem areas in physics publishing, the Project is concerning itself with faster and more economical indexing, abstracting and publishing in the field of physics. ***R. E. Maizell.*** *Physics Today,* v. 13, Oct. 1960, p. 42 + 2 pages.

* **Deciding What to Read to Keep Informed.** The number of technical journals continues to increase but the time available for reading remains constant. Suggests a practical plan which helps the individual to solve this personal problem. ***C. W. Hanson.*** *Engineering,* v. 190, Sept. 16, 1960, p. 378-379.

* **Scientific Russian Without Tears. I. The Alphabet.** ***J. W. Perry.*** *Chemical Age,* v. 84, Oct. 1, 1960, p. 541-542.

* **Data Handling by Card Manipulation.** Gives a consistent language for use in discussing methods of data handling, by which data is classified by "unit", "feature", "item", and "compound". Tells how questions are handled in a data system using this consistent language. ***J. L. Jolley.*** *Journal of Documentation,* v. 16, no. 3, Sept. 1960, p. 132-143.

* **A Microfilming Program for Laboratory Notebooks.** The case of the laboratory notebook is a special one not only because the notebook is a unique record but also because the record of experimental work constitutes the major documentary support for patent applications. The notebook filming program described meets the objective set by management of providing a security copy of a unique and irreplaceable primary record. ***Meredith S. Wright.*** *Special Libraries,* v. 51, no. 8, Oct. 1960, p. 425-428.

* **Technical Correspondence: Control and Retrieval Through Microfilm and Punch Card Techniques.** These techniques are not limited to the processing of correspondence. They can also be quite useful in the handling of technical reports, papers and journal articles. ***Thomas J. Devlin and W. T. King.*** *Special Libraries,* v. 51, no. 8, Oct. 1960, p. 421-424.

* **Techniques of Gathering Technical Information.** Techniques useful in interviewing technical personnel are described. ***Harry Baum.*** *STWP Review,* v. 7, no. 4, Oct. 1960, p. 8-11.

* **Documentary Control Aspects in Report Writing.** The Armed Services Technical Information Agency (ASTIA) is the scientific information center of the Department of Defense. As such, it must promote the most efficient use of its raw product, the technical report. ASTIA strongly encourages the preparation of abstracts and catalog information at the source of a report and the inclusion of this information on 3x5 in. catalog cards as an integral part of the report; preparation of unclassified titles and abstracts wherever possible and so marked in the document; and production of reproducible copies. ***J. Heston Heald.*** *STWP Review,* v. 7, no. 4, Oct. 1960, p. 21-22.

* **The Professional Man and the Obligation of Authorship.** There exists an inherent moral obligation on every technically trained man, whether scientist or engineer, to make the results of his work known to others in the same field. The scientist cannot escape his obligation to publish the truth as he sees it, nor can the engineer escape his obligation to hand down the accumulated knowledge of his profession. ***Merritt A. Williamson.*** *STWP Review,* v. 7, no. 4, Oct. 1960, p. 12-14.

* **The Automatic Construction of a Glossary.** The automatic construction of a glossary is similar in principle to the manual construction but the logical rules by which the construction is made are more complicated because the store of an electronic computer, unlike a card index, is limited in size and, in general, is not large enough to contain the entire glossary of a text of average length. There are many ways of overcoming this difficulty and two of the more reasonable ones are discussed in this article. ***Andrew J. T. Colin.*** *Information and Control,* v. 3, no. 3, Sept. 1960, p. 211-230.

* **Better Written Reports.** The quality of written reports is one criterion for estimation of the caliber of an organization. Internal reports are judged by employees and managers; papers in journals make their impression on all who read them, but carefully prepared documents exert an influence of even greater depth. They can actually increase the effectiveness of organizational planning and research. ***Robert F. Marschner and J. O. Howe.*** *Reearch Management,* v. 3, no. 3, Autumn 1960, p. 147-155.

INSTRUMENTATION

Moiré Fringe Reading Head for Use With a Fine Grating. Describes an optical system in which the use of a separate index grating is avoided, the moiré fringes being formed between the scale grating and the image formed by its reflexion in a concave mirror. This arrangement has the particular advantage that the sensitivity is doubled. ***D. A. Palmer.*** *Journal of Scientific Instruments,* v. 37, Aug. 1960, p. 261-262.

Some Modifications to an Oscilloscope Camera, and the Construction of a Control Unit. A Langham-Thompson series 200 camera was modified to provide facilities for printing frame numbers along the edge of the photographic film, and to give warning when the supply of film is exhausted. The camera is used in conjunction with a control circuit. ***M. H. Evans and G. Pierson.*** *Journal of Scientific Instruments,* v. 37, Aug. 1960, p. 282-284.

Temperature Regulator for Close Temperature Control. Describes the design and performance of an electronic temperature regulator for an analytical oven of special construction. Stable temperature control with a resettability of better than 1 C is obtained over the range of 150-550 C. ***E. N. Herzberg.*** *Journal of Scientific Instruments,* v. 37, Aug. 1960, p. 285-289.

Intracardiac Catheter Tip Piezoresistive Pressure Gauge. A pressure gage is described that can be encased in a small-bore plastic catheter. The small size permits insertion directly into the heart. The unit uses a two-section piezoresistive element, operated as a cantilever. The sensitivity of the gage is 0.16 mv/v/psi, and the frequency response is flat from 0 to 400 cps. ***Max Traite, Walter Welkowitz, and Rudolph Downs.*** *Review of Scientific Instruments,* v. 31, Sept. 1960, p. 987-991.

A New Refractive Index Gradient Recording Interferometer Suitable for Studying Diffusion, Electrophoresis and Sedimentation. A new simple and versatile interferometer was developed in which the interference fringes produce a direct plot of the refractive index gradient. The fringe system appears within a *sharp image* of the cell, each fringe representing the refractive index gradient curve for that part of the cell through which the fringe passes. The distance between the fringes can be varied by varying the parameters of the arrangement. The theory of the optical method is given in detail together with an estimate of possible errors. The records of some diffusion experiments are reproduced. ***Olof Bryngdahl and Stig Ljunggren.*** *Journal of Physical Chemistry,* v. 64, Sept. 1960, p. 1264-1270.

Ratiometer for Low-Current Mass Spectrometry. Individual ions in the beam are detected, and an automatic switching device counts the total number of ions in each of the two mass beams being compared. The system is simple to operate and has been found to give very accurate results. ***F. D. S. Butement and N. P. Finkelstein.*** *Journal of Scientific Instruments,* v. 37, Sept. 1960, p. 328-332.

Isotopic Analysis of Boron in Boron Trifluoride by Mass Spectrometry, and Measurement of Natural Boron 10 Concentration. By blending together enriched and depleted boron trifluoride, standard samples with known isotopic constitutions are prepared and used to calibrate the mass spectrometer. The true and measured isotope ratios are thus found to differ by several per cent. After correcting for this error, the boron 10 atomic concentration in some naturally-occurring B is found to be 19.27 ± 0.13%. ***P. G. Bentley.*** *Journal of Scientific Instruments,* v. 37, Sept. 1960, p. 323-328.

Apparatus for the Measurement of the Thermal Diffusivity of Solids at High Temperatures. An apparatus is described for measuring the thermal diffusivity of solids in the temperature range 30-1000 C. It employs a method in which the dispersion and the attenuation of a thermal wave, propagated through the solid, are measured. The theory underlying this method is presented, and results are given of measurements on Armco Fe and Ge. ***B. Abeles, G. D. Cody, and D. S. Beers.*** *Journal of Applied Physics,* v. 31, Sept. 1960, p. 1585-1592.

Digital Instrumentation for Nuclear Research Tests. A detailed account of how digital techniques have been used in a 256-channel neturon analyzer is given. These channels are time intervals in which nuclear measurements take place. ***E. J. Wade.*** *Electronics,* v. 33, no. 43, Oct. 21, 1960, p. 68-71.

Infrared Gage Measures Hot Steel Strip Width. Measuring the width of strip steel within one-eighth inch when the strip is heated to approximately 2100 F and moving at speeds up to 3000 ft/min is a problem. This gage solves it. ***Fred J. Danks.*** *Electronics,* v. 33, no. 43, Oct. 21, 1960, p. 65-67.

Infrared Methods. Principles and Applications. Describes sources of radiation, optical materials, detectors, amplifiers, and dispersive systems. Discusses various applications, including instruments for gas analysis, plant control, and radiation pyrometry. ***G. K. T. Conn and D. G. Avery.*** v. VII. 203 pp. 1960. Academic Press, New York. (QC457 C76i)

Telemetry System for Testing Automobiles. The system allows measurement of up to 23 parameters. Sketches and diagrams show the operating of the system. ***Alan Potton.*** *Electronics,* v. 33, no. 43, Oct. 21, 1960, p. 57-59.

Acta Imeko 1958. Proceedings of the International Measurements Conference, Budapest, November 24-30, 1958. v. I.-V. Papers cover geometric, mechanical, optical, thermal, electrical, and magnetic measurements, electronic instruments, physico-chemical, and nuclear measurements. Economic, organizational, and manufacturing problems are included. (*In Hungarian, German, English, French, Russian.*) v. I. 428 pp.; v. II. 444 pp.; v. III. 372 pp.; v. IV. 460 pp.; v. V. 419 pp. 1959. Hungarian Scientific Society for Measurement and Automation, Budapest. (OC100.5 In8.5p)

* **Perforated-Tube Flowmeter.** Describes a cheap and simply constructed visual flow-meter. It consists of a Rotameter-type bob fitting fairly close inside a perforated tube. Most of the fluid flows out of the holes below the bob; the height of the bob indicates the flow-rate. A simple theoretical treatment is given. ***P. V. Danckwerts and A. K. Sikder.*** *Chemical Engineering Science,* v. 13, no. 1, Aug. 1960, p. 34-38.

A Four-Channel Continuously Recording Monitor for Air-Borne Alpha-Activity. An air monitor is described which samples air-borne radioactivity at four remote locations and records the α activities on a strip chart recorder at a central location. Automatic range and time-constant switching is provided. ***D. A. Morken and R. H. Wilson.*** *U. S. Atomic Energy Commission, UR-576,* July 25, 1960, 31 pp. (UF767 Un3.1ru Contin.)

High-Vacuum Techniques. Considerations of high-vacuum technology covered in this report are: basic design considerations of vacuum systems; high-vacuum processes, such as vacuum firing, vacuum evaporation, sputtering, and tube processing; handling of high-vacuum equipment; choice of high-vacuum materials; methods of leak detection. ***G. L. Krieger.*** *U. S. Atomic Energy Commission, SCTM-76-60(14),* Mar. 4, 1960, 30 pp. (UF767 Un3.1sct Contin.)

* **Applying Ultrasonic Viscometers to Polymer Processes.** Monsanto research learned which polymer systems ultrasonic viscometers can measure and compared them to the falling plunger and rotating spindle type. The ultrasonic viscometer is a useful instrument for polymer process analysis—rugged, easy to install in many processes, and of good accuracy. Calibration is required for each new application and correlation with the desired variable is essential. ***A. W. Wotring and T. B. McAveeney.*** *ISA Journal,* v. 7, Oct. 1960, p. 67-69.

Surface Area Determination of Magnesium Powder With Chromium-51 Tracer Solutions. A study has been made of the adsorption of ^{51}Cr, from aqueous solutions of labelled potassium dichromate, onto coarse magnesium powder at room temperature. The measurement of the rate of uptake of ^{51}Cr on the powder and comparison with a magnesium standard of known area has led to a simple method for the determination of the surface area of the powder. ***H. P. Dibbs.*** *Journal of Applied Chemistry,* v. 10, pt. 9, Sept. 1960, p. 372-377.

Frequency Counter. This frequency counter uses countdown technique to obtain direct-reading accuracy of a low frequency (400 cps) to one part in 40,000, without waiting for 40,000 counts (cycles). ***Ross E. Hupp.*** *Instruments and Control Systems,* v. 33, Oct. 1960, p. 1715.

LUBRICATION AND FRICTION

Wall Effect in the Flow of Lubricating Greases in Plunger Viscometers. In the plunger viscometer, grease is sheared between the surface of a long piston, or plunger, and the inner wall of a coaxial cylinder, the motion of the plunger being along the long axis of the cylinder. For some greases the flow curves depend on the width of the gap between the plunger and the cylinder, while for others the flow curves are independent of the gap width. ***A. D. Bramhall and J. F. Hutton.*** *British Journal of Applied Physics,* v. 11, Aug. 1960, p. 363-371.

* **Fundamental Processes in Lubricating Metal Surfaces at 100F to 1700F.** Friction, wear, and surface damage involving multi-component solid lubricants containing graphite, boron oxide, silver chloride, silver fluoride, metal phthalocyanine, molybdenum disulfide, lead oxide, and sodium silicate were calculated. Chemical reactions (decomposition, oxidation, reduction, and combination to form new compounds) are activated in the surface and bulk films. Adherence, metal solubilities, and changes in the shear properties of the lubricants are most important. ***E. N. Klemgard.*** *Lubrication Engineering,* v. 16, Oct. 1960, p. 468-476.

* **Effect of Oil Viscosity on Rheological Properties of Lubricating Greases.** Relationships between the rheological properties of plastic suspensions and those of their suspending liquids. ***B. W. Hotten and A. L. McClellan.*** *NLGI Spokesman,* v. 24, no. 7, Oct. 1960, p. 268-273.

* **Non-Soap Lubricating Greases.** Aryl ureas indanthrenes possess the properties required for modern lubricating greases. The new thickeners may be used with conventional oils to

produce excellent multi-purpose greases. Consideration is being given to thickeners, oils, and test devices for service at 700 F. ***L. C. Brunstrum.*** *NLGI Spokesman*, v. 24, no. 7, Oct. 1960, p. 279-283.

The Lubrication of Bearings at High Temperatures. Much work on high temperature conditions and bearing material/lubricant combinations must be carried out before all the problems are solved. Promising combinations with certain limitations are: self-lubricating bearings, gas lubricated bearings, organic liquid "once-through" systems, solid lubricants and controlled atmospheres. ***E. G. Ellis.*** *Scientific Lubrication*, v. 12, Sept. 1960, p. 16 + 6 pages.

MECHANICAL ENGINEERING

* **Analysis of Stress Concentrations at Reinforced Holes in Infinite Sheets.** Equations are derived which enable the stresses around a compactly reinforced hole in an infinite sheet to be computed. The only restrictions placed on the shape of the hole are that it has at least one axis of symmetry and that the region outside it can be conformally mapped onto the region outside the unit circle by a transformation function in the form of a polynomial of any order. ***W. H. Wittrick.*** *Aeronautical Quarterly*, v. 11, pt. 3, Aug. 1960, p. 233-247.

* **Design Charts for Transient Temperature and Thermal Stress Distributions in Thermally Thick Plates.** The method is based on repetitive applications of the exact analytical solution to a unit triangular variation of the adiabatic wall temperature and a constant heat transfer coefficient. The actual variation of the adiabatic wall temperature is represented as a series of straight lines while the heat transfer coefficient is approximated by a step function. ***J. S. Przemieniecki.*** *Aeronautical Quarterly*, v. 11, pt. 3, Aug. 1960, p. 269-284.

* **Design Criteria for Reinforced Columns Under Axial Load and Biaxial Bending.** Several design criteria for columns subjected to compression combined with biaxial bending are discussed. The approximate load-carrying capacity is defined in terms of easily determined parameters without the cumbersome trial-and-error procedures. ***Boris Bresler.*** *American Concrete Institute, Journal*, v. 32; *ACI Proceedings*, v. 57, no. 5, Nov. 1960, p. 481-490.

* **Resistance to Shear of Reinforced Concrete Beams. IV. Behavior of Beams With Different Types of Web Reinforcement.** A comparison of beams with different types of web reinforcement shows that bars inclined at 45° to the axis of the beam are most effective in resisting the diagonal tension stresses. To offer full protection from shear, however, the use of vertical stirrups and bent-up bars combined is preferable. The alternative of orthogonal web reinforcement, consisting of vertical stirrups and horizontal bars at, and possibly also below, the neutral axis, is discussed, and experimental data are presented. ***A. M. Neville and J. Taub.*** *American Concrete Institute, Journal*, v. 32; *ACI Proceedings*, v. 57, no. 5, Nov. 1960, p. 517-532.

* **Simplifying Ultimate Flexural Theory by Maximizing the Moment of the Stress Block.** A method of simplifying ultimate flexural analysis is described. The stress block is defined by a method of maximizing the moment of the stress block about the neutral axis. Three separate stress functions are used to describe the stress in the concrete. The calculated type of failure and the ultimate moment are compared with results of reinforced concrete beam tests. ***Lyle E. Young.*** *American Concrete Institute, Journal*, v. 32; *ACI Proceedings*, v. 57, no. 5, Nov. 1960, p. 549-556.

On the Associated Flow Rule of Plasticity Based on Crystal Slips. To simplify the calculation of the ultimate load that a structure may carry, aggregates of differently orientated metal crystals with finite elastic constants are considered. The coincidence of the plastic potential with yield surface of these polycrystalline aggregates is theoretically derived from the slip characteristics of single crystals. The deviation of the plastic potential from the yield surface of the aggregate increases with the elastic anisotropy of the individual crystals. ***T. H. Lin.*** *Franklin Institute, Journal*, v. 270, no. 4, Oct. 1960, p. 291-300.

On the Pure Bending of an Elastic, Perfectly Plastic Curved Bar in the State of Plane Strain. In this complete treatment of the problem, regimes of Tresca's yield surface are encountered in which σ_2 is no longer the intermediate principal stress, rendering the problem statically indeterminate. Depending on the parameters of the problem, four types of solutions are possible in which as many as six plastic zones with different stress fields may be present. Appropriate stress distributions are derived and complete results presented for a typical stage of deformation for one type of problem. ***S. A. Murch.*** *Franklin Institute, Journal*, v. 270, no. 4, Oct. 1960, p. 301-316.

Creep Deformation and Stresses in Pressurized, Long Cylindrical Shells. The state of deformation and stress in a long, circular, cylindrical shell with freely supported or clamped ends, loaded by uniform lateral pressure, is analyzed under condition of slow stationary creep. Use is made of an approximate method based on a general extremum principle for dissipative media. ***M. P. Bieniek and A. M. Freudenthal.*** *Journal of the Aero/Space Sciences*, v. 27, Oct. 1960, p. 763 + 4 pages.

Initially Warped Sandwich Panel Under Combined Loadings. The applied loads consist of arbitrarily distributed transverse loads and eccentrically applied edge loads and/or edge moments. For the case of a simply supported rectangular panel, solutions of the differential equations are obtained in the form of double Fourier series. ***Chieh C. Chang and Bertrand T. Fang.*** *Journal of the Aero/Space Sciences*, v. 27, Oct. 1960, p. 779-787.

Plastic Bending of a Work-Hardening Circular Plate With Clamped Edge. The plate material is assumed to follow the yield condition of von Mises and to harden isotropically. The incremental stress-strain law is used. The possibility of partial unloading of the plate material during the loading cycle is investigated. The problem is represented as two sets of two simultaneous differential equations corresponding to the loading and unloading portions of the plate material. They are solved by the NCR-304 Digital Computer. ***Chintsun Hwang.*** *Journal of the Aero/Space Sciences*, v. 27, Nov. 1960, p. 815 + 6 pages.

Elastic Instability of a Cylindrical Shell Under Arbitrary Circumferential Variation of Axial Stress. The buckling stress of a cylindrical shell is determined for various circumferential distributions of axial stress. The development is based on small deflection theory, with finite difference techniques being applied to derive the general form of the governing algebraic linear homogeneous equations. The equations are cast in both the determinant and matrix forms, the latter being suitable for the commonly used matrix iteration solution. Numerical results are obtained by means of a high-speed digital computer for cases wherein the stress distribution is described by 32 circumferential elements. It is found that the buckling stress for pure bending, and for more complicated circumferential stress distributions of the axial stress as well, is not much higher than for uniform axial compression. Cases are indicated where small deflection theory is directly applicable. ***P. P. Bijlaard and R. H. Gallagher.*** *Journal of the Aero/Space Sciences*, v. 27, Nov. 1960, p. 854 + 5 pages.

A Simple Method of Matric Structural Analysis. V. Structures Containing Plate Elements of Arbitrary Shape and Thickness. Simple equations are used to treat plate elements. The equations are basic equilibrium and force-displacement equations. The plate elements may be of any shape and have any thickness variation. The stresses in the elements may vary in a complex pattern. There need not be any edge members attached to the plates. All equations are simple to derive and simple in principle. Most equations contain definite integrals. Since in general the shapes and thicknesses of the plate elements are arbitrary, a simple numerical integration scheme is used to evaluate these integrals. Numerous numerical examples are worked out to illustrate the mechanics of the method and the accuracy attainable. ***Bertram Klein.*** *Journal of the Aero/Space Sciences*, v. 27, Nov. 1960, p. 859-866.

Vibration Resistance of Thread-Locking Devices. New test method rates how various ESNA-type locknuts perform during vibration, and how they compare with plain nuts. ***K. R. Bronson and C. C. Faroni.*** *Product Engineering*, v. 31, no. 42, Oct. 10, 1960, p. 58-61.

Too Hot for Hydraulics? Try Pneumatics for High-Temp Systems. Electromagnetic devices normally used for amplifying and controlling output and input signals are not reliable at extremely high temperatures. The fluid amplifier developed at the Army's Diamond Ordnance Fuze Lab is used for this purpose. Principle of operation is simply the deflection of a high-power stream of gas by a low-power stream at right angles to it. In effect, the high-power stream is "aimed" by the low. Useful temperature can be extremely high—it is limited only by the metal or ceramic chosen. Speed of response of a pneumatic amplifier is slower than that of an electronic version; it is roughly in the ratio of the speed of sound to the speed of light. ***John W. Billheimer and John K. Wetherbee.*** *Product Engineering*, v. 31, no. 43, Oct. 17, 1960, p. 68-69.

The Effect of End Conditions on the Dynamic Response of Cylindrical Shells. A circular cylindrical shell of a rigid plastic material is uniformly loaded by a radial step pressure pulse. Explicit formulas are obtained for the maximum deformation in the shell as a function of the shell geometry and pressure magnitude. It is found that for moderately long shells, the deformation is essentially independent of the support conditions at the end of the shell. ***R. L. Chiapetta and P. G. Hodge, Jr.*** *U. S. Atomic Energy Commission, ARF* 4132-8, July 1960, 62 pp. + 5 pages. (UF767 Un3.1ar Contin.)

Compressive Buckling Curves for Flat Sandwich Panels With Dissimilar Facings. Presents curves and formulas for use in calculating the buckling of flat, simply supported panels of sandwich construction under edgewise compressive loads. The curves apply particularly to sandwich panels having one facing of glass-fabric laminate, the other facing of an isotropic material, and a honeycomb or isotropic core. ***Charles B. Norris.*** *U. S. Forest Products Laboratory Report No.* 1875, Sept. 1960, 12 pp. (TS800 Un3.3r Contin.)

Structural Behavior of Pressurized, Ring-Stiffened, Thin-Wall Cylinders Subjected to Axial Compression. The axisymmetric mode of deformation of pressurized circular cylinders subjected to compressive end loads is examined and discussed with the aid of available theory. Stresses and deformations obtained with the theory are compared with those obtained in tests of a 7075-T6 aluminum-alloy thin-wall cylinder with high internal pressure. The observed behavior of the test cylinder was substantially in agreement with predictions. In addition, an application of the theory is used to explain the seemingly high buckling stresses usually obtained in bending tests of pressurized cylinders compared with those obtained in compression tests of pressurized cylinders. ***James P. Peterson and Marvin B. Dow.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN*-D-506, Oct. 1960, 24 pp. (TL570 Un3t Vis.)

The In-Plane Vibrations of a Flat Spinning Disk. Analyzes the static and vibrational in-plane deformations of a thin, flat, elastic, homogeneous disk rotating at a constant speed. A disk attached to a rigid central hub of finite diameter and a freely spinning disk are considered. ***James G. Simmonds.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN*-D-521, Oct. 1960, 44 pp. (TL570 Un3t Vis.)

METALLURGY

Review of Problems in Using Flat-Rolled Materials in Air- and Space-Weapon Systems. It has been estimated that, within five years, materials will be expected to operate at 1200 F for reasonably long times and at or above 2000 F for a few minutes. Within ten years, operational temperatures are expected to reach 2500 F for a few minutes and 4000 F for a life of a few seconds. Deals mainly with problems in producing and using sheet materials intended for service at high temperatures. ***F. W. Boulger.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 52, Apr. 14, 1960, 20 pp. (TN799 B32.2d Contin.)

Metallurgical Characteristics of A-286 Alloy. A-286 alloy is a high-temperature alloy that can cause many problems in fabrication unless its characteristics are recognized. The recommended ranges of chemical composition are shown. The absence of B from this material can cause a soft, weak, lamellar-type precipitate after age hardening. This condition is accentuated if cold working precedes aging. This type of precipitate is illustrated. Bulging of assemblies during pressure testing has occurred when this precipitate is present, stress-rupture values are very low, and creep rate increases manyfold. ***Hiram Brown.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 59, July 26, 1960, 7 pp. (OTS)

New Alloys Combine Strength With Ease of Fabrication. New Jalloy-S steel series developed by Jones & Laughlin Steel Corp. are fabricated via "restrained quenching" to develop high strength with welding and forming ease. *Iron Age*, v. 186, no. 13, Sept. 29, 1960, p. 124-125.

What Are the Combined Effects of Temperature and Very High Pressure on Metals? The inception of high-pressure, high-temperature operations has opened many new avenues of investigation. Discusses possible effects of both on electrical resistance, ductility, hardening, and other mechanical and structural properties of metals. ***R. B. Fischer.*** *Journal of Metals*, v. 12, Sept. 1960, p. 700-702.

Recent Advances in Beryllium Metallurgy. Sound metallurgical approaches toward understanding, as well as eliminating, and the persistent problem of brittleness in Be metal are described. ***S. H. Gelles, J. J. Pickett, and A. Wolff.*** *Journal of Metals*, v. 12, Oct. 1960, p. 789-792.

Development of Refractory Metal Sheet in the United States. The new airframe applications for refractory metals in aircrafts, missiles, and space vehicles will require primarily sheet. Development of high-quality sheet products and components of the four major refractory metals is being accelerated in the U.S. Emphasis is being placed on relatively thin gage sheet of normal sizes, but with exceptional surface quality and gage control. Strength appears secondary to fabricability and quality. ***R. I. Jaffee, W. J. Harris, Jr., and N. E. Promisel.*** *Journal of the Less-Common Metals*, v. 2, nos. 2-4, Apr.-Aug. 1960, p. 95-103.

Modern Industrial Uses of the Platinum Metals. Platinum is used for electrodes in sparking plugs, in the chemical and petroleum industry (cracking, isomerisation, hydrogenation, sulfur removal), in the pharmaceutical industry, as anodes in electrolysis, and in the glass industry. ***W. Betteridge and D. W. Rhys.*** *Metal Industry*, v. 97, Sept. 2, 1960, p. 183-185.

How to Get More From Modern Steels. Discusses possibilities of improvement of carbon, leaner alloy and H-steels; leaded grades; steels for cold extrusion; vacuum-processed alloys; aircraft and missile alloys; nuclear steels; coated products; metallurgically tailored stainless steels. *Metal Progress*, v. 78, no. 4, Oct. 1960, p. 71-83.

Progress in Aluminum Alloys. New alloys and improved techniques, such as plaster core and vacuum die casting, enable parts to be cast which have better physical properties and a brighter surface. New wrought alloys have better weldability. Increased corrosion resistance in severe environments is provided. *Metal Progress*, v. 78, no. 4, Oct. 1960, p. 137-142.

Progress in Copper Alloys. "Biofouling" is prevented by Hg added to Cu; an age-hardenable bronze finds use for cold headed bolts; Cu plus 0.15% Zr has good stiffness and electrical conductivity; Li is a useful deoxidizer; tubes of Sn-lined Cu and Cu-lined stainless steel answer corrosion problems. *Metal Progress*, v. 78, no. 4, Oct. 1960, p. 143 + 5 pages.

Progress in Magnesium Alloys. Two new wrought alloys—ZE 10 A and ZK 21 A—require no stress-relief after welding; precision extrusions minimize machining; new casting alloys—ZK 61 A, QE 22 A, EK 31 XA, HM 11 XA—offer improved properties at room and elevated temperatures. ***James V. Winkler.*** *Metal Progress*, v. 78, no. 4, Oct. 1960, p. 146 + 4 pages.

Niobium—Promising High-Temperature Reactor-Core Material. Among refractory metals, Nb stands out for reactor use at over 1600 F. It offers—along with low capture cross section—high strength alloys, fabricability and stability in nonoxidizing environments. ***J. A. DeMastry and R. F. Dickerson.*** *Nucleonics*, v. 18, Sept. 1960, p. 87 + 5 pages.

Rolling of Uranium Sheet and Its Properties. Studies on Uranium Fuel Element (2). Bomb-reduced U, melted in vacuum high-frequency furnace, was rolled at room temperature at 300 and 600 C. Microstructures, hardnesses, thermal expansion, and X-ray diffraction patterns of the rolled specimens were determined. ***Kyoaki Taketani, Yoshikata Sasaki, and Masayoshi Kuihara.*** *U. S. Atomic Energy Commission, AEC-tr-4172,* Sept. 1960, 17 pp. (UF767 Un3.1ae Contin.) (Translated from *Journal of the Atomic Energy Society of Japan,* v. 1, no. 5, 1959, p. 319-329.)

Melting and Forming of SER Fuel Rods. Sixty-one metal-alloy rods were fabricated for the SNAP Experimental Reactor (SER), a compact nuclear power source. These rods were 1 in. in diameter by 10 in. long, and consisted of an alloy containing 7 wt% highly enriched U and 93% Zr. Melting of the alloy was done by generally accepted consumable arc-melting techniques. Extrusion of alloy slugs into rods was carried out, unclad, at 850 F. Suitable controls were developed to insure uniformity of products and reproducibility of batches. The procedures developed for this application are considered adequate for future requirements. ***P. S. Drennan.*** *U. S. Atomic Energy Commission, NAA-SR-4762,* Oct. 1, 1960, 25 pp. (UF767 Un3.1na Contin.)

Technical Progress Report to the AEC Reactor Division for the Period Ending June 30, 1959. Cold working of U, high-temperature moderator and fuels, β-beryllium phase alloy program, uranium monocarbide, glass lubricated extrusion process, and casting of thorium and uranium alloys are discussed in detail. *U. S. Atomic Energy Commission, NMI-1216,* July 21, 1960, 156 pp. (UF767 Un3.1nm Contin.)

Year Book of American Iron and Steel Institute. Discusses operating experience with the nuclear-ray blast-furnace stock gage, predicting effect of O, moisture and fuel additions on blast-furnace operation with electronic computers, some features of basic oxygen steelmaking with basic hot-blast cupolas, and the use of oxygen lances and basic brick in open-hearth furnace roofs. 305 pp. 1960. American Iron and Steel Institute, New York. (TS300 Am35y Vis.)

METALS—CORROSION

Corrosion Inhibition on Steel Tubes in Low-Pressure Steam Boilers. A number of recommendations are advanced regarding water side care of low-pressure steel boilers; the authors believe a general increase in operational reliability will result if these are carefully followed. ***W. A. Keilbaugh and F. J. Pocock.*** *ASHRAE Journal,* v. 2, Oct. 1960, p. 70 + 10 pages.

The Mechanism of Oxidation of Iron in Carbon Monoxide-Carbon Dioxide Mixtures. The oxidation of iron in CO-CO_2 mixtures was studied in the temperature range of 925-1075 C. For oxide thicknesses between about 4×10^{-4} and 1.8×10^{-3} cm, the oxidation rate was found to be a linear function of the mole fraction of CO_2 in the gas phase and the sum of the partial pressures of CO_2 and CO between 0.4 and 1.0 atm pressure. These data confirm the rate-determining step for the process to be the dissociation of CO_2 into CO and adsorbed O atoms or ions. ***F. Pettit, R. Yinger, and J. B. Wagner, Jr.*** *Acta Metallurgica,* v. 8, Sept. 1960, p. 617-623.

* **Corrosion Resistance of Titanium Alloys.** Testing the corrosion resistance of the Ti alloys VT-5, VT-3, VT3-1 revealed their low resistance in sulfuric and hydrochloric acids, a decreased resistance in phosphoric acid, and a high resistance in acetic acid. In the most aggressive medium, however, such as boiling sulfuric acid, there are alloys, with Mo and Si, which exhibit higher resistance than commercial Ti. (*In Russian.*) Korrozionnaia stoĭkost' titanovykh splavov. ***V. V. Zholobov and A. S. Kudukis.*** *Akademiia Nauk SSSR, Otdelenie Tekhnicheskikh Nauk, Izvestiia, Metallurgiia i Toplivo,* 1960, no. 4, July-Aug., p. 77-80.

* **Corrosion of Prestressed Wire in Concrete.** After a brief review of the various types of corrosion, the few corrosion failures which have occurred in prestressed wire in concrete are discussed. Field and laboratory observations indicate clearly that calcium chloride in concrete may lead to serious corrosion of prestressing steel. Because of this hazard, it is recommended that calcium chloride not be used in prestressed concrete. ***G. E. Monfore and G. J. Verbeck.*** *American Concrete Institute, Journal,* v. 32, *ACI Proceedings,* v. 57, no. 5, Nov. 1960, p. 491-515.

The Rusting of Cast Iron. Illustrates various examples of formation of rust and gives a brief outline of the electrochemical process involved; the factors which affect the point of precipitation of rust are described, and the way in which a rust film may protect the Fe from further corrosion is explained. ***H. H. Collins.*** *B.C.I.R.A. Journal,* v. 8, no. 5, Sept. 1960, p. 742-750.

Stress-Corrosion Cracking of Ti-5Al-2.5 Sn. A large number of unexplained cracks were encountered in the fabrication of complex assemblies of Ti-5Al-2.5Sn. These were not the usual stress cracks, but consisted of regular families of cracks in certain areas. This cracking sometimes occurred during welding but was particularly prevalent after heat treatment. Efforts to repair-weld the areas usually resulted in further propagation of the cracks. Laboratory investigation and a survey of technical literature indicated that the cracking was similar to stress-corrosion cracking due to chlorides. Source of halides was trichloroethylene, used in standard degreasing practice; when new cleaning methods were substituted, problem of stress-corrosion cracking was eliminated. ***Hiram Brown.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 60, Aug. 4, 1960, 11 pp. (TN799 B32.2d Contin.)

Separation of the Defect Concentration and Diffusion Coefficient in Diffusion-Limited Scaling Reactions. In diffusion-limited scaling reactions the rate constant is proportional to the quantity DC_0, where D and C_0 are the diffusion coefficient and the solubility of the defect whose motion through the growing scale is essential to continued reaction. In order to separate D and C_0, recourse is usually made to an independent measurement of one or the other, which is a difficult and frequently unreliable procedure. A new technique is proposed which permits the accurate and simultaneous determination of D and C_0 from reaction rates alone. The method is based on the controlled interruption of a scaling reaction and possesses a rigorous internal check. It is applicable in principle to any such reaction, and the necessary mathematical formulation is presented in a convenient analytical form. Conventional experimental techniques can be used when $C_0 >> 10^{17}$ cm^{-3}. The treatment is illustrated for the oxidation of InSb. ***Arthur J. Rosenburg.*** *Electrochemical Society, Journal,* v. 107, Oct. 1960, p. 795-799.

Cathodic Processes on Passive Zirconium. Measurements were made of the rates of reduction of various oxidizing agents on passive Zr in acid solutions of sodium sulfate at temperatures ranging from 25 to 85 C. The oxidizing agents included in these experiments were O, H ion, and cupric ion and hydrogen peroxide in the presence of O. The kinetic orders of reduction were determined from potentiostatic experiments in which the current was determined as a function of concentration. Unit and fractional orders were observed with O reduction, and fractional orders from about 0.5 to 0.65 were observed for Cu^{++} and H_2O_2. Possible mechanisms are suggested in which charge transfer through the film is assumed to play a predominant role. ***Robert E. Meyer.*** *Electrochemical Society, Journal,* v. 107, Oct. 1960, p. 847-853.

Effects of Diffusion on Corrosion of Metals by Fused Salts. In equimolar NaCl, KCl, at 800 C it is almost invariably found that stainless steels form internal voids. These are considered to be the result of internal diffusion and selective oxidation of one or more of the components. Metallographic examination of the corroded alloys indicated in this instance that the selective removal of Cr was responsible for the formation of voids. ***C. Edeleanu, J. G. Gibson, and J. E. Meredith.*** *Iron and Steel Institute, Journal,* v. 196, pt. 1, Sept. 1960, p. 59-61.

Rate of Oxidation of Magnesium Metal in Dry Oxygen. The oxidation of Mg sheet, polished by surface evaporation, was investigated with the aid of the thermal balance, and in the early regions by a manometric method, at temperatures between 470° and 570° and for times up to 120 hr in dry O. The oxidation curves of weight-gain against time show, in most cases investigated, three main regions: an early region during which lateral growth of white oxide across the metal is observed; a

linear branch in which the rate of thickening and of cracking of the oxide film are apparently equal; a stage in which the rate is initially higher than for the two preceding regions although it tends to decrease with increase of time. The reaction mechanism is discussed in view of the current theories of the oxidation of metals. ***R. Sh. Mikhail and V. K. Gouda.*** *Journal of Applied Chemistry*, v. 10, pt. 9, Sept. 1960, p. 384-388.

Reaction With Hydrofluoric Acid of Oxygen- and Hydrogen-Containing Zirconium and the Structure of the Alloy. From dissolution experiments of the respective Zr alloys in HF, it is shown that O is not occluded in Zr, but is bound to form domains of ionized ZrO_2, which may agglomerate to ZrO_2 grains, sparingly soluble in HF while the alloy is soluble in dilute HF. Conversely, H is occluded or dissolved in Zr (forming ZrH_x), but probably only in those parts of the metal which are free of Zr^{4+} and O^{-2} ions (of ZrO_2). Thus the solubility of H_2 in this free Zr should be higher than that usually reported by various authors who consider only the weight of O. When ZrH_x is dissolved in HF, the H_x is quantitatively liberated as a gas; ZrO_2 when present in the samples and especially when present as a surface film remains as a residue. ***M. E. Straumanis, W. J. James, and C. S. Lin.*** *Journal of Applied Chemistry*, v. 10, pt. 9, Sept. 1960, p. 389-392.

The Oxidation of Intermetallic Compounds. I. High Temperature Oxidation of InSb. II. Interrupted Oxidation of InSb. I. ***Arthur J. Rosenberg and Mary C. Lavine.*** II. ***Arthur J. Rosenberg.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1135-1150.

Development of Oxidation Resistance of Some Refractory Metals. Investigations into the protection of Nb and Mo from oxidation by alloying and by applied coatings are described. The Nb alloy containing 17.5 at.% W, 17.5 at.% Ti, and 5 at.% Fe shows a great improvement in oxidation resistance over unalloyed Nb, but is not to the standard required for an oxidation-resistant alloy. An Al-Cr-Si coating affords protection to Mo against oxidation at 1,200 C for 150-200 hrs, and the coating shows considerable resistance to thermal shock. Attempts to apply a protective coating to Nb have not been successful. ***G. L. Miller and F. G. Cox.*** *Journal of the Less-Common Metals*, v. 2, nos. 2-4, Apr.-Aug. 1960, p. 207-222.

Oxidation Behaviour of Niobium-Chromium Alloys. An examination of the properties of chromium niobate indicates the possibility of producing an oxidation-resistant Nb-Cr alloy. A series of such alloys were prepared and subjected to oxidation tests. Tests on one of these alloys in different atmospheres reveal a considerably higher oxidation rate in air than in O. A possible mechanism is suggested to account for this phenomenon. ***G. T. J. Mayo, W. H. Shepherd, and A. G. Thomas.*** *Journal of the Less-Common Metals*, v. 2, nos. 2-4, Apr.-Aug. 1960, p. 223-232.

The Effect of Oxygen Pressure on the High Temperature Oxidation of Tantalum. The pressure dependence of the linear rate constant for the oxidation of Ta was investigated in the temperature range 600-900 C and the pressure range 1-760 mm Hg. The results confirm that the controlling step is preceded by an equilibrium adsorption process and indicate that at low pressures the rate-controlling step depends on the square root of the O pressure. At lower temperatures and higher pressures another process controls the rate, which varies linearly with pressure. Possible reaction mechanisms are proposed to account for the observations. ***M. G. Cowgill and J. Stringer.*** *Journal of the Less-Common Metals*, v. 2, nos. 2-4, Apr.-Aug. 1960, p. 233-240.

*** Study on the Corrosion of Stainless Steels in High Temperature Gas. I. Corrosion of 18Cr-8Ni Stainless Steel in Carbon Dioxide Gas.** The surface of steel began to be covered with thin films of straw color at temperatures near 300 C, and the corrosion reaction proceeded with growth of the surface films at higher temperatures. ***Tadashi Yanagihara, Goro Shimaoka, Seiichi Ikeda, Hiroko Suzuki, and Atsushi Takei.*** *National Research Institute for Metals, Transactions*, v. 2, no. 1, 1960, p. 43-50.

The Tarnish Resistance of Gold Plating Over Silver. Gold plating in thicknesses of as much as 0.2 mil is frequently applied over Ag plating to protect the latter from tarnishing. However, many instances of tarnishing of parts so plated have occurred. An accelerated exposure test was devised that will duplicate

the tarnish and a quantitative method of evaluating the degree of tarnish was developed. Tests of 300 plated panels showed that Au plating 0.2 mil thick over Ag is sufficiently porous to allow tarnishing to occur, and that in order to produce a reliably nontarnishing surface, 0.4 mil of Au is necessary. It is recommended, therefore, that in applications where tarnishing cannot be allowed that Ag plating be eliminated and Au alone used. ***William B. Harding.*** *Plating*, v. 47, Oct. 1960, p. 1141-1145.

*** The Anodic Passivation of Some Chromium-Nickel-Manganese Steels Under Constant Current Conditons.** The passivation of three Cr-Ni-Mn steels during a constant anodic current in solutions containing H_2SO_4- and H_2SO_4 Na_2SO_4 of different pH (0.3-6.5) were examined. The mechanism of the passive layer formation resembles that occurring in the case of Al, Zr, Ta, Ti, and Nb high-grade steels. An electronically conducting layer is formed. In the transpassivity zone, this layer exhibits a secondary passivity. (*In German.*) Über die anodische Passivierung einiger Chrom-Nickel-Mangan-Stähle bei konstantem Strom. ***I. G. Murgulescu and O. Radovici.*** *Zeitschrift für Physikalische Chemie* (Leipzig), v. 214, nos. 5-6, 1960, p. 288-298.

METALS—EXTRACTION AND REFINING

Fundamentals of Melting in the Hot Blast Cupola. A comparison of hot-blast and standard cold-blast cupola performances. Deals with the advantages and applications of high-temperature blast for the cupola. ***A. C. Buesing.*** *Foundry*, v. 88, Nov. 1960, p. 96-99.

The Effect of Flow Distribution on Air Preheat in the Open-Hearth Furnace. Investigations into the flow of air and waste gases through cold open-hearth furnace regenerators showed severe maldistribution. By the use of suitably disposed baffles and guides in the flues, regenerators, and on the bridgewall, it has been shown that improvements in distribution can be achieved. When these modifications were built into the furnaces, the air preheats were increased and savings in fuel effected. ***J. Chapman and W. Montgomery.*** *Iron and Steel Institute, Journal*, v. 196, pt. 1, Sept. 1960, p. 15-28.

Some Observations on the Interaction of Liquid Sodium With Cast Irons and Plain Carbon Steels. Decarburization of Na depends on the presence of a "sink" in which the C removed from the specimen may be deposited. Cast irons are rapidly penetrated by the Na and modification of the microstructure in the interior of the specimen may result, even where there is no removal of C from the Fe. The formation of surface layers and crystals has been noted on steels immersed in Na, and these are ascribed to the transport of material from the container in which the test is carried out. Some measurements have also been made of the rate of decarburization of plain carbon steels by Na over the temperature range 600-850 C, and the results correlated with the Fe-C phase diagram and the diffusion rates of C in ferrite and austenite. ***A. A. Smith and G. C. Smith.*** *Iron and Steel Institute, Journal*, v. 196, pt. 1, Sept. 1960, p. 29-42.

Investigations on the Tuyere and Combustion Zones in Blast-Furnaces and Low-Shaft Furnaces. The nature and particle size of the coke are particularly important factors. The configuration of the combustion zone in front of the tuyeres in the low-shaft furnace is the same as the long-known configuration in the blast-furnace. There is no unique correlation between the extent of the combustion zone and the depth of the tuyere zone; the influence of blast temperature and exit velocity is nevertheless discernible. ***Rolf Ebert and Karl-Friedrich Lüdemann.*** *Iron and Steel Institute, Journal*, v. 196, pt. 1, Sept. 1960, p. 46-50.

Acid Smelting of Foundry Pig Iron in Low-Shaft Furnaces. Conclusion of these tests is that the efficiency of pig-iron production can be considerably improved by utilization of the acid smelting process. This may be attributed to increased economies in fuel and limestone, as well as an appreciable increase in production. It is possible to improve the pig-iron quality so that it is equivalent to that obtained by basic smelting. ***Georg von Struve.*** *Iron and Steel Institute, Journal*, v. 196, pt. 1, Sept. 1960, p. 50-56.

Electron Beam Fusion and Its Applications. A general account is given of the principles involved in the production and utilization of electron beams for fusion applications. A more detailed discussion is made of the advantages of the process over induction or arc fusion methods for welding, ingot production and zone refining from a metallurgical and operational point of view. Details are given of equipment under development for ingot production and zone refining. ***N. F. Eaton.*** *Journal of the Less-Common Metals*, v. 2, nos. 2-4, Apr.-Aug. 1960, p. 104-112.

* **Vacuum Induction Melting High Strength Steels.** General quality improvements are made in high strength steel castings by the application of vacuum induction melting techniques. Theoretical considerations of crucible-melt reactions, deoxidation, desulfurization, degasification, dissociation and volatilization are applied to the conduct of vacuum heats. Appreciable reduction in residual gas content and size and frequency of nonmetallic inclusions is obtained. This reduction results in increased ductility and toughness, especially at the ultra high strength levels, over steel castings produced by conventional air melting methods. ***P. S. Schaffer, P. J. Ahearn and M. C. Flemings.*** *Modern Castings*, v. 38, Oct. 1960, p. 95-112.

* **Ball Bearing Steel Made With a Vacuum Induction Furnace.** Researches were made on the austenitizing behavior and durability of ball bearing steel, made with a vacuum induction furnace, by means of the Rockwell hardness test, lineal analysis, X-ray integrated intensity method, electrolytic isolation method, and rapid life-testing machine. ***Manabu Ueno and Hirooki Nakajima.*** *National Research Institute for Metals, Transactions*, v. 2, no. 1, 1960, p. 13-17.

* **Preparation of High Purity Silicon by the Thermal Decomposition of Silicon Tetraiodide or the Hydrogen Reduction of Silicon Tetrachloride.** The iodide process and the H reduction process of silicon tetrachloride were investigated as methods for preparing high purity Si. The reactions in these processes are both heterogeneous. In the iodide process, the amount of Si deposit depends on the amount of iodide introduced into the quartz tube, the temperature of silicon tetraiodide, the temperature of the decomposition furnace, and on the thermal decomposition time. ***Katashi Masumoto and Hideo Kaneko.*** *National Research Institute for Metals, Transactions*, v. 2, no. 1, 1960, p. 25-29.

* **Testing Carbon Linings of Blast-Furnace Stacks.** To increase the service life of carbon blocks used in blast-furnace stacks, the porosity and reactivity of carbon refractories must be reduced greatly, making them at the same time fine grained in structure. ***F. A. Khil'kevich, B. L. Lazerev, S. V. Bazilevich, and V. K. Korner.*** *Stal' in English*, 1960, no. 5, May, p. 309-313.

* **Effect of Blast Temperature on Blast-Furnace Operation.** An increase in blast temperature is accompanied by a reduction in coke rate, reduction in gas temperature in the bosh parallel, and an increase in the carbon dioxide content in the gas in the upper part of the stack; the degree of direct reduction does not change substantially. ***N. N. Babarykin and F. A. Yushin.*** *Stal' in English*, 1960, no. 5, May, p. 314-318.

* **Operating Experience of a Blast-Furnace With Evaporative Cooling.** Describes evaporative cooling on a 1033 m^3 furnace and gives a brief account of operations since it was blown in in Nov. 1957. ***P. G. Glazkov and D. E. Krasnozhen.*** *Stal' in English*, 1960, no. 5, May, p. 323-325.

* **The Theory of the Dephosphorization Process.** A theoretical analysis of the order of oxidation of impurities in pig iron and of experimental data confirms that oxidation reactions occur not in the interior of the metal but at the slag-metal interface. When converting phosphoric pig iron, the equilibrium of the P reaction is limited by the structure of the silico-phosphates which are formed and does not depend on the O content of the pig iron and of the carbonaceous metal. Discusses the mechanism of the dephosphorization process. ***I. Yu. Kozhevnikov.*** *Stal' in English*, 1960, no. 5, May, p. 326-334.

The Manufacture of Iron and Steel. v. I. Iron Production. v. III. Steelworks Fuels, Furnaces, Refractories and Instruments. Volume I includes Fe ores and their occurrence; preparation of Fe ores; blast furnace equipment, design, and practice; blast furnace refractories; other methods of pig iron production; manufacture of ferro-alloys and special irons; and wrought iron. Volume III includes open hearth fuels; producer gas; liquid fuels; the open hearth plant and equipment; the open hearth furnace; steelworks instruments; steelworks refractories; and refractory, policy and control. ***G. Reginald Bashforth.*** v. I. 2nd Ed. 313 pp. v. III. 246 pp. 1960. Chapman & Hall Ltd., London, England. (TN705 B29m2)

METALS—FINISHING, POLISHING AND CLEANING

Cleaning and Pretreatments Prior to Painting. II. Cleaning and Finishing of Metals. Methods of dirt removal; application of cleaners and preparatory pre-coatings. ***J. H. Goodyear.*** *Industrial Heating*, v. 27, Oct. 1960, p. 2178 + 4 pages.

Finishing Supplement: Electropolishing Copper Alloys—A Revival. Reviews electrolytic polishing and describes the process, raw material, equipment, and fields of application of electropolishing of copper alloys. ***H. E. Zentler Gordon and S. C. Boyle.*** *Metal Industry*, v. 97, Sept. 16, 1960, p. 227-230.

Modern Ideas on the Mechanical Polishing of Metals. A widely accepted view is that mechanical polishing occurs by a process of surface flow, producing a drastically altered, amorphous-like layer known as the Beilby layer. Evidence obtained recently indicates that this is not so, at least when metals are polished by the use of fine abrasives. The new evidence indicates that polishing occurs primarily by cutting, producing a crystalline, but plastically deformed surface. ***L. E. Samuels.*** *Research Applied in Industry*, v. 13, Sept. 1960, p. 344-349.

* **Bonderizing for Wire-Drawing.** A review of the use of bonderizing in the wire industry and some recent developments in its use as an aid to drawing and cold heading. *Wire Industry*, v. 27, Sept. 1960, p. 881 + 3 pages.

METALS—FOUNDRY PRACTICE

Some Experiments on Hot Tearing in White Cast Iron. The causes of hot tearing are not fully understood, and the B.C.I.R.A. is engaged in a program of research. Some of the more definite results so far obtained are reported, and indicate that in restrained bar test castings the incidence of hot tearing increases with length of bar and pouring temperature, and it is more likely to occur when dry sand molds are used. ***J. Rickard.*** *B.C.I.R.A. Journal*, v. 8, no. 5, Sept. 1960, p. 667-674.

* **Some Highlights in the Experience of a Foundryman.** Manufacture of a number of Fe and steel castings requiring the best service qualities. In the nonferrous field, particulars are given of the production of large high-speed Al-bronze propellers and six-bore bronze pump barrels. ***E. Longden.*** *British Foundryman*, v. 53, Aug. 1960, p. 345-362.

* **Plastic Patterns.** Describes the long period of development work in the field of plastic patterns, and gives details of the most recent methods of manufacture using epoxy resins. ***J. W. John.*** *British Foundryman*, v. 53, Aug. 1960, p. 362-369.

* **Some Aspects of Small Foundry Practice.** The general methods used to maintain a high standard of light-casting production in a variety of materials in a small ferrous and nonferrous foundry are described. In the nonferrous shop, melting methods and treatment of metals cover a range from aluminum alloys, through gunmetals and phosphor bronzes to high-tensile brass, aluminum bronze, and copper. In the iron foundry, reference is made to cupola control, chemical analyses, and castings required to withstand pressure tests and checks for chill depth to assist in maintaining machinability and maximum strength. Some of the problems associated with shell molding, and the action taken to overcome them, are also described. ***F. P. Robinson.*** *British Foundryman*, v. 53, Aug. 1960, p. 379-386.

* **Effect of Mode of Solidification on the Fluidity of Aluminium-Tin Alloys.** The fluidity of Al of 99.99% purity was found to be substantially higher than Al of 99.9% purity. All of the Al-Sn alloys examined possessed much lower fluidity than pure Al. Solidification and cessation of flow occurs in pure Al fluidity-test castings by choking of liquid flow with a solid ring of metal forming at or near the entrance of the flow channel. Cessation of flow in dilute Al-Sn alloys also occurs by solidification at or near the entrance of the flow channel. Cessation of flow in Al-Sn alloys containing substantial amounts of Sn occurs by precipitation of fine grains at or near the tip of the flowing stream. ***S. Feliu, M. C. Flemings, and H. F. Taylor.*** *British Foundryman*, v. 53, Sept. 1960, p. 413-425.

* **A Study of the Cooling of Molten Cast Iron in the Casting Ladles.** An investigation of the protective measures to be applied in order to limit the cooling of metal, in this case of gray cast iron, in 30, 40, 60, and 80 kg capacity ladles. **(*In French.*)** Étude du refroidissement de la fonte liquide dans les poches de coulée. ***Maurice Decrop and Jean-Paul Aymard.*** *Fonderie*, no. 176, Sept. 1960, p. 359-370.

Casting Submarine Parts in CO_2 Process Molds. At this foundry, production of castings of one kind seldom exceeds three. Often they are required on short notice. The CO_2 process satisfies the requirements of low production and rush jobs. ***Robert H. Herrmann.*** *Foundry*, v. 88, Nov. 1960, p. 100-102.

Mineralogy of Molding Sand. Covers occurrence of sand, fundamental properties, grain geometry, and processing features. ***W. P. Winter.*** *Foundry*, v. 88, Nov. 1960, p. 103-105.

Gating of Aluminum Diecastings. Describes a scientific approach to gating of Al diecastings, and also discusses other variables in the diecasting process. ***Earle W. Rearwin.*** *Foundry*, v. 88, Nov. 1960, p. 106-113.

Breakability of Knock-Off Risers. Knock-off risers are effective only when they are designed and used properly. Discusses proper practice and results of testing various shapes and sizes of knock-off riser cores. ***P. K. Sandell.*** *Foundry*, v. 88, Nov. 1960, p. 92-95.

Influence of Increased Lead Content on Pressure-Tightness of Leaded Gunmetal. Deals with experiments conducted in Sweden to continue previous research which seeks to explain the good "castability" of leaded gunmetal. The author describes his own experiments and those of his colleagues, and applies the results in substantiation of a further theory. ***Lars Ekbom.*** *Foundry Trade Journal*, v. 109, Sept. 22, 1960, p. 355-360.

Investment Casting in Vacuum. Descriptions of equipment and operating procedure. ***L. S. Taylor.*** *Foundry Trade Journal*, v. 109, Oct. 6, 1960, p. 419-427.

* **Treating Cast Iron Melts With Ultrasonics.** By means of a magnetostrictive double oscillator, cast iron melts of different chemical compositions were treated with ultrasonics for different periods of time before casting. Untreated melts were kept for comparison. There was no difference in tensile strength, brinell hardness and bending strength of the two groups of specimens. The ultrasonic treatment of a solidified melt caused a slight strength increase. (*In German.*) Die Behandlung von Gusseisenschmelzen mit Ultraschall. ***Alfred Kolorz.*** *Giesserei*, v. 47, no. 17, Aug. 25, 1960, p. 447-451.

* **Critical Assessment of Different Gating Systems for Sand Moulds.** Calculation of the gate cross-sections, cross-section ratio, down-gate, runner, ingate, necessity of avoiding depression and admission of air, retention of the impurities, and general remarks. (*In German.*) Kritische Untersuchung verschiedener Einlaufsysteme für Sandformen. ***Charles Trenckle.*** *Giesserei*, v. 47, no. 19, Sept. 22, 1960, p. 519-526.

* **Dust Abatement Problems in the Foundry Industry.** Sand conveying and preparation plants as the main sources of dust; full-automatic wet dust removing plant, design of piping systems; verification of the design of dust-removing plants offered; design of the exhaustion hoods, and supply of fresh air. (*In German.*) Staubbekämpfungsprobleme in der Giessereiindustrie. ***Ulrich Klinge.*** *Giesserei*, v. 47, no. 19, Sept. 22, 1960, p. 526-530.

* **Planning, Controlling and Following-Up of Delivery Times in Foundries.** Planning chart; apparatus used; comprehension of a working process; advantages of the method described. (*In German.*) Planen, Steuern und Verfolgen von Terminen in Giessereibetrieben. ***Arthur Obergethmann.*** *Giesserei*, v. 47, no. 19, Sept. 22, 1960, p. 530-533.

* **Safety in Pressure Die Casting Foundries by Using Hydraulic Liquids of a High Flash-Point.** The causes of the danger of fire when using ordinary hydraulic liquids were determined. The most important groups of hydraulic liquids of high flash-point and their characteristics are described. (*In German.*) Sicherheit in Druckgiessereien durch Verwendung von schwer entflammbaren Hydraulikflüssigkeiten. ***Ernst Umhöfer.*** *Giesserei*, v. 47, no. 20, Oct. 6, 1960, p. 548-550.

Pressure-Poured Steel. A Key to Lower-Cost Steel Mill Operations? A technique, now being used to cast steel railway wheels, is undergoing pilot-plant operations designed to test its applicability to cast semi-rolled steel shapes. ***F. Weston Starratt.*** *Journal of Metals*, v. 12, Sept. 1960, p. 698-699.

* **Effects of the Mineralogical Composition and Properties of Different Sand Types on the Behavior of the Mold Material Prepared With These Sands.** The components considered were quartz, Zr ($ZrO_2.SiO_2$) and rutile (TiO_2). Chamotte, olivine, sillimanite, corundum and quartz glass were examined in preparing synthetic sands. Study of behavior of sand mixtures for molds, resistivity to fire, expansion behavior, reaction between the metal and mold, and behavior from the bonding material viewpoint. (*In Dutch.*) De invloed van de mineralogische samenstelling en eigenschappen van verschillende zandsoorten op het gedrag van het hieruit bereide vormmateriaal. ***K. Verstraete.*** *Metalen*, v. 15, no. 16, Aug. 31, 1960, p. 279-281.

* **Five New Tests for Controlling Shell Molding Sand Mixtures.** AFS Shell Mold and Core Committee Report. Details are given for determining melt point, hot tensile strength, hot deflection, transverse strength, and permeability. *Modern Castings*, v. 38, Oct. 1960, p. 55-59.

* **Sand Angularity and Shape Factors.** Theoretical concepts of describing shapes, sharp corners, edges and surface of foundry sands by numbers and ratios of surface area to volume are comprehensive but limited. The microscope still remains the only tool capable of assigning a relative shape. ***G. J. Vingas and A. H. Zrimsek.*** *Modern Castings*, v. 38, Oct. 1960, p. 73-82.

* **Shaw Process Patterns, Principles and Production.** Covers the Shaw Process history, molding procedure, and some of the various fields of application in this country, and evaluates the process and application of Shaw Process castings to the pattern-making industry. ***I. Lubalin and R. J. Christensen.*** *Modern Castings*, v. 38, Oct. 1960, p. 83-94.

* **Hypoeutectic Gray Cast Iron Ladle Additions.** Gives data on the effectiveness of pure Si and Al as addition agents, and on graphite as an innoculant. Data are presented on the effect of Ca, Si-Al and graphite additions on the eutectic temperature. Describes experiments designed to determine the effect of these elements on the nucleation of solidification and transformation of hypoeutectic irons. ***D. D. McGrady, C. L. Langenberg, D. J. Harvey, and H. L. Womochel.*** *Modern Castings*, v. 38, Oct. 1960, p. 113-122.

* **Aluminum Alloy Die Casting.** Draws comparisons between the different trends in Britain and the U.S. with regard to the use of the gravity and pressure die casting processes. Notes the predominance of the pressure process in the U.S.A., and of the gravity method in Britain, and describes some of the underlying reasons. The factors influencing the choice of each method in Britain, including costs, surface finish and dimensional accuracy, are illustrated. ***R. R. Woodward and H. J. Proffitt.*** *Modern Castings*, v. 38, Oct. 1960, p. 123-136.

Zinc Permanent Mold Castings. Etablissements Mecal, Aubervilliers, France, specializes in the production of zinc alloy permanent mold castings for industrial applications where high strength and good finish are essential. The results are very good. ***Hiram K. Barton, editor.*** *Precision Metal Molding*, v. 18, Sept. 1960, p. 63-65.

METALS—HEAT TREATMENT

Effect of Heat Treatment on the Hardness and Microstructure of 30 Per Cent Chromium Cast Irons. Eight compositions nominally 27 or 33% with 1 or 2% C and 1 or 2% Si were examined. It was found that martensite tempered fairly readily at 600 C and that increases in hardness attributed to "475 C Embrittlement" were also lessened by treatment at this temperature. ***J. W. Boyes.*** *B.C.I.R.A. Journal*, v. 8, no. 5, Sept. 1960, p. 726-741.

* **A Contribution to the Problem of the Shrinkage Mechanism During the Sintering of Metal Powder Compacts.** Heterodiffusion in the surface layers of the particles during annealing of powder mixtures of different metals causes a decrease of the shrinkage value in compacts made of these powders. In the absence of a liquid phase, the diffusion processes play a prevalent part in the reconstruction process of the surface layer of the particles, but not the diffusion processes inside the particles. (*In Russian.*) K voprosu o mekhanizme usadki pri spekanii briketov iz metallicheskikh poroshkov. ***I. M. Fedorchenko and N. V. Kostyrko.*** *Fizika Metallov i Metallovedenie*, v. 10, no. 1, July 1960, p. 75-83.

* **A Contribution to the Study of the Nature of the Maximum Internal Frictions in Steel After Thermal Treatment.** A 200°-maximum internal friction in thermally worked and deformed steel was studied. The effects of cold working, hardening from subcritical temperatures and cold deformation on the same maximum value were examined. In the case of hardened and tempered steel, this maximum is due to the simultaneous occurring of some relaxation processes in the field of stresses, such as the diffusion of C atoms in residual austenite, the migration of C atoms in the region of dislocations, etc. (*In Russian.*) K voprosu o prirode maksimuma vnutrennego treniia v stali posle termicheskoĭ obrabotki. ***Iu. V. Piguzov, M. A. Krishtal, and C. A. Golovin.*** *Fizika Metallov i Metallovedenie*, v. 10, no. 2, Aug. 1960, p. 285-290.

Heat Treating the Stainless Steels. VI. Heat treatments for precipitation hardening stainless steels. ***S. W. Cole.*** *Industrial Heating*, v. 27, Oct. 1960, p. 2037 + 8 pages.

* **Heating Large Size Ingots in Regenerative Pits.** The transition to large size ingots increases the productivity of the pits because of the increase in the weight of the molten charge and better conditions of the heat exchange. The specific duration of the heating process, equal to 8.7 mm/cm for the cold treatment, decreases to 4.0 mm/cm for the hot treatment (750 C). The value of the heat conductivity of the ingots, which can be used for perfecting the conditions of heating, was calculated. (*In Russian.*) Nagrev krupnykh slitkov v regenerativnykh kolodtsakh. ***N. Iu. Taits, E. M. Gol'dfarb, and A. N. Minaev.*** *Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Chernaia Metallurgiia*, 1960, no. 8, p. 160-166.

Modern Quenching Techniques Make It Easier to Heat Treat Steel. With the proper quenchant, steels ranging from the plain C grades to the high-alloyed stainless types can be readily quenched with little danger of cracking or warping. Discusses specific characteristics of each medium, from brine to air, along with descriptions of equipment. *Metal Progress*, v. 78, no. 4, Oct. 1960, p. 101-111.

Measuring Quenching Rates With the Electronic Quenchometer. When a pure Ni ball is heated to 1625 F and dropped into the tube of the quenchometer it actuates the timer. When the ball cools past the Curie point—about 670 F for Ni—the reactance in the induction coil changes, and the timer stops. Thus, the time needed for the ball to cool from 1625 F to the Curie point of Ni is a measure of the effectiveness of the quench. ***H. J. Gilliland.*** *Metal Progress*, v. 78, no. 4, Oct. 1960, p. 111-113.

* **Gas-Fired Heat-Treatment Furnaces.** Describes some British installations. *Metal Treatment and Drop Forging*, v. 27, Sept. 1960, p. 357-361.

Stress Relieving by Flexible Furnace. Flexible furnaces permit heat treatment operations for very large or long welded fabrications previously considered impracticable; units consist of mats composed of ceramic heads threaded on nickel-alloy heat-resistant wire linked together to provide a series of electrical circuits giving a maximum surface temperature of 1000 C. *Metallurgia*, v. 62, Aug. 1960, p. 65-68

* **A New Multi-Purpose Induction Hardening Machine.** ***Peter Wiehn.*** *Siemens Review*, v. 27, no. 7, Aug. 1960, p. 235-238.

* **Improving Rail Quality by Deep Quenching.** The wear resistance of rails can be improved by deep quenching in oil using the Nizhne-Tagil' practice. ***S. V. Gubert and D. M. Rabinovich.*** *Stal' in English*, 1960, no. 5, May, p. 345-349.

* **The Heat-Treatment of Spring Alloys Used at High Temperatures.** The optimum heat-treatment processes which have been worked out make it possible to manufacture springs for working at temperatures of up to 300 C from Type EI702 steel with 5%Mo (N36KhTYuM5) and at up to 500 C from the alloy N80Kh12TYuVB. Type N36KhTYu steel will only give stable operation up to 200 C. ***A. G. Rakhshtadt, V. A. Sol'ts, and V. F. Moiseev.*** *Stal' in English*, 1960, no. 5, May, p. 374-378.

Carburization of Austenitic Stainless Steel in Liquid Sodium. Results of experimental research concerned with carbon transfer in liquid sodium–304 stainless steel systems. The general nature of the reactions is discussed, and experimental techniques are described. The reaction rates in the liquid sodium system were found to be rapid, and carburization rates for the steel were governed by diffusion rates. The carbon content of 304 stainless steel in equilibrium with carbon-saturated sodium varies from 2.68% at 1000 F to 4.35% at 1600 F. A method of using microhardness data from carburized stainless steel specimens for indirectly determining the carbon content of sodium is described. ***W. J. Anderson and G. V. Sneesby.*** *U. S. Atomic Energy Commission, NAA-SR-5282*, Sept. 1, 1960, 27 pp. (UF767 Un3.1na Contin.)

* **Huge Gantry Furnace to Aid Missile Industry.** New furnace designed by Lindberg Engineering Co. will be used for heat treatment of thin-walled rocket motor cases, precision controlled for physical properties and driven signal tolerances. ***Ed Howard.*** *Western Metalworking*, v. 18, Sept. 1960, p. 33-34.

METALS—MECHANICAL AND PHYSICAL PROPERTIES

Polyslip in Single Crystals. Simultaneous slip on six or eight glide systems in f.c.c. single crystals was studied by work-hardening, surface, and X-ray observations, and theoretically. Experiments were done on Al at room temperature, on four of the five crystallographic types of polyslip. They show that there are two extremely different kinds of behavior, typified by <100> and <111> tension. ***U. F. Kocks.*** *Acta Metallurgica*, v. 8, June 1960, p. 345-352.

Elastic Constants of Copper-Nickel Alloys. The elastic constants of single crystals of Cu and of dilute alloys of Cu with Ni were measured using the ultrasonic pulse-echo technique. All fundamental elastic constants increase with composition in contrast to results previously obtained for solutes to the right of Cu in the periodic table. ***R. E. Schmunk and Charles S. Smith.*** *Acta Metallurgica*, v. 8, June 1960, p. 396-401.

A Study of Elongation and Ageing in Al-4% Cu and Al-4% Cu 0.05% In Crystals. The relation between deformation characteristics and θ' nucleation were studied in Al-4% Cu and Al-4% Cu 0.05% In crystals. Preferred nucleation of θ' occurs in the orientations which do not contain the slip direction in the $(100)_{\theta'}$ plane. This is attributed to the atomic configuration at the edges of partial dislocations. Deformation of aged crystals has shown that crystals hardened by G.P. [1] at 130 C show characteristics similar to those of "as quenched" crystals. The slip lines are fainter and fewer when G.P. [2] zones are present, and are not detected at all until heavy deformations when large quantities of θ' are present. This is attributed to different hardening mechanisms. ***J. M. Silcock.*** *Acta Metallurgica*, v. 8, Sept. 1960, p. 589-597.

Fatigue Data on Precipitation-Hardenable Stainless Steels. Semiaustenitic steels constitute one group of commercial precipitation-hardenable stainless steels. Steels of this group have the characteristic of being austenitic in the solution-annealed condition and martensitic after aging and heat treatment. Some commercial alloys of this group for which fatigue data are available are 17-7PH, AM350, and AM355. Fatigue notch sensitivity of the 17-7PH appears comparable with corresponding values for some comomn steels and for some aluminum alloys. ***R. J. Favor, H. J. Grover, and W. P. Achbach.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 46, Mar. 11, 1960, 15 pp. (TN799 B32.2d Contin.)

References to Research on High-Emissivity Surfaces. Reviews work of a number of projects which have been established to develop improved methods of measuring emissivity and to determine the emissivity of various materials at both high and low temperatures. ***J. W. Holladay.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 57, June 27, 1960, 8 pp. (TN799 B32.2d Contin.)

Vapor Pressures of Platinum Metals. I. Palladium and Platinum. Langmuir free-evaporation rates for Pd and Pt samples of high purity establish the equilibrium vapor pressures and the heat of sublimation. For Pt: log $P_{mm}^{solid} = 10.362 - 29.100/T$; $\Delta H°_{298} = 135.2 \pm 0.8$ kcal/mole; estimated b.p. = 4100 ± 100 K. For Pd: log $P_{mm}^{solid} = 9.075 - 19{,}425/T$; $\Delta H°_{298} = 91.0 \pm 0.8$ kcal/mole; estimated b.p = 3200 ± 100 K. ***Lloyd H. Dreger and John L. Margave.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1323-1324.

Deformation, Fracture, and Radiation Damage, in Body-Centred Cubic Transition Metals. Recent advances in the dislocation theory of the deformation and fracture of body-centered cubic transition metals are reviewed. The theory is still largely phenomenological and is formulated in terms of the parameters σ_i and K_y in the empirical relation $\sigma_y = \sigma_i + K_y d^{-\frac{1}{2}}$ between yield stress and grain diameter. The application of the theory to body-centered cubic transition metals other than iron and steel was hindered by the absence of reliable values of σ_i and K_y. Recent values obtained for Mo and Nb explain why the ductile-brittle transition temperature of Mo is much higher than that of Nb. ***A. A. Johnson.*** *Journal of the Less-Common Metals*, v. 2, nos. 2-4, Apr.-Aug. 1960, p. 241-252.

Mechanical Properties Attainable by Alloying of Refractory Metals. Surveys W, Mo, Ta, and Nb alloys. ***B. S. Lement and I. Perlmutter.*** *Journal of the Less-Common Metals*, v. 2, nos. 2-4, Apr.-Aug. 1960, p. 253-271.

* **The Effect of Electroplating on Fatigue Strength.** The fundamental limitation of Ni and Cr coatings is their relatively low intrinsic fatigue strength relative to the high-strength steels to which they are frequently applied (aggravated by tensile internal stress). A need exists, therefore, for investigating the possibilities of electrodepositing stronger coatings. In the case of Ni, this is clearly feasible by the use of organic addition agents in the plating bath, which could have the added advantage of imparting compressive internal stress to the electrodeposit. The prospects of applying a similar remedy for Cr deposits are far less promising, however. ***R. A. F. Hammond and C. Williams.*** *Metallurgical Reviews*, v. 5, no. 18, 1960, p. 165-223.

* **Study on Chromium-Base Heat-Resisting Alloys. I. Effect of Cobalt on the High Temperature Properties of 60% Cr-25% Fe-15% Mo Type Alloys.** The liquidus temperature of the alloys was lowered by replacing Fe with Co. The more the content of Co increased, the higher the hardness of the alloys became. The most desirable combination of strength and ductility in this alloy system occurred by replacing Fe with Co below 15%. ***Tetsutaro Mitsuhashi, Renpei Yoda, and Masao Yakushiji.*** *National Research Institute for Metals, Transactions*, v. 2, no. 1, 1960, p. 18-24.

Creep in Face-Centred Metals and Solid Solutions With Special Reference to α-Brasses. The creep of α-brasses containing 10-35% Zn was studied in the range 350-650 C. A peak in the activation energy H' (below σ_c') close to the composition represented by Cu_3Zn is interpreted in terms of local order near dislocation cores. This affects the migration of jogs and hence recovery by climb. ***P. Feltham and G. J. Copley.*** *Philosophical Magazine*, v. 5, ser. 8, July 1960, p. 649-667.

a • **Recovery of Quenched-in Resistivity at High Temperatures in Gold.** Two recovery regions were defined: the first region was found within a wide temperature range, 200 to 600 C; the second region was observed within a very narrow temperature range about 630 C. Complete recovery occurred during this stage. ***M. Meshii and J. W. Kauffman.*** *Philosophical Magaine*, v. 5, ser. 8, July 1960, p. 687-690.

b • **Effect of Temperature on Yield and Flow Stress of B.C.C. Metals.** A comparison of data on yielding and flow of b.c.c. metals indicates that the proportional limit, the yield stress, the friction stress of Heslop and Petch, and the flow stress after some strain beyond the Lüders strain, all exhibit the same strong temperature dependence. This suggests that they all represent the same deformation mechanism. ***Hans Conrad.*** *Philosophical Magazine*, v. 5, ser. 8, July 1960, p. 745-751.

c • **Low-Temperature Specific Heat of Body-Centered Cubic Alloys of 3*d* Transition Elements.** The electronic specific heat coefficient was measured in the temperature range 1.4 to 4.2 K for 48 solid-solution alloys in the following binary systems: Ti-V, V-Cr, V-Fe, Cr-Mn, Cr-Fe, and Fe-Co. The electronic specific heat vs electron concentration curves show three well-separated regions of high density of states. The first of these occurs in alloys with atomic magnetic moments near zero. The second one is found in alloys which have increasing magnetic moments with increasing electron concentration, up to Fe + 35% Co along the Pauling-Slater curve. The third region of high density of states extends from Fe + 35% Co to the limit of the bcc solid solutions at Fe + 75% Co, a range where the magnetic moment decreases with increasing electron concentration. ***C. H. Cheng, C. T. Wei, and P. A. Beck.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 426-436.

d • **Internal Friction in Germanium and Silicon. I. Electron and Impurity Relaxation. II. Oxygen Movement and Dislocation Damping.** The internal friction of single crystal Si and Ge at 100 kc/s shows a relaxation peak near 0.56 of the melting temperature. The peak is electronic in origin and the relaxation time is the carrier lifetime. If impurities are introduced so that the extrinsic lifetime becomes less than the intrinsic lifetime at the peak temperature, then the peak height is reduced. Recombination centers are induced when oxygen-containing Si is cooled rapidly from above 1000 C to 650 C, reducing the lifetime to less than 0.35 μsec, which then recovers at a rate which increases with successive heat treatments. Dislocation relaxation produces a rise in internal friction at elevated temperatures, an activation energy of 1.1 ev in Ge and 1.5 ev in Si being associated with the rise. ***P. D. Southgate.*** *Physical Society, Proceedings*, v. 76, pt. 3, Sept. 1960, p. 385-408.

e • * **Thermal Expansion of Rhodium-Platinum Alloys.** Gives thermal expansion characteristics of a number of rhodium-platinum alloys at temperatures up to 1500 C. ***B. Barter and A. S. Darling.*** *Platinum Metals Review*, v. 4, no. 4, Oct. 1960, p. 138-140.

f • **Theory of Ultrasonic Attenuation in Metals and Magneto-Acoustic Oscillations.** The problem is reduced to a calculation of the currents set up in a stationary lattice by forces on the electrons, some real (due to electric fields) and some fictitious to describe the disturbances due to the passage of the wave. It is assumed, as is valid for ultrasonic frequencies below about 10^9 c/s, that the electric fields serve to annul any electronic current relative to the lattice. The expressions obtained are qualitatively similar to the earlier results for a free-electron model; in particular, the attenuation tends to a constant limit as the electronic free path becomes infinite. The analysis is extended to cover the situation which arises in a transverse magnetic field, in the limit when the free path is long compared with the electronic orbit perimeters. ***A. B. Pippard.*** *Royal Society, Proceedings*, v. 257, ser. A, Sept. 6, 1960, p. 165-193.

g • **The Thermal and Magnetic Properties of Some Transition Element Alloys.** Results of measurements of the magnetic susceptibilities of a series of binary alloys are presented. The systems investigated were Pd-Rh, Pt-Ir, and Pt-Au. Certain similarities between the alloys of Pd alloyed with Ag or Rh, and those of Pt alloyed with Au or Ir are apparent. In addition, the specific heats of Pd-Rh and Pt-Au alloys were measured

h • i • j • k •

in the liquid He temperature range, and the electronic heats and Debye temperatures computed. ***D. W. Budworth, F. E. Hoare, and J. Preston.*** *Royal Society, Proceedings*, v. 257, ser. A, Sept. 6, 1960, p. 250-262.

Investigation of Problems Associated With the Use of Alloyed Molybdenum Sheet in Structures at Elevated Temperatures. The results of an experimental study to explore the capabilities and limitations of thin Mo-0.5Ti molybdenum-alloy sheet for structural applications at high temperatures are presented. Evaluation tests at temperatures ranging from room temperature to 3,000 F were made on resistance-welded corrugated-core sandwiches that were coated with a commercially available oxidation-resistant coating known as W-2 and on coated oxidation and tensile specimens. The performance of the corrugated-core sandwiches in compressive strength and static oxidation tests, tensile properties of the coated molybdenum sheet, and the life of the coated specimens in static oxidation tests are given. A description of the equipment and procedures utilized in performing the evaluation tests is included. ***Eldon E. Mathauser, Bland A. Stein, and Donald R. Rummler.*** *U. S. National Aeronautics and Space Administration, Technical Note, NASA TN*-D-447, Oct. 1960, 60 pp. (TL570 Un3t Vis.)

METALS—MECHANICAL WORKING

Turning of High-Strength Steels in the Hardness Range of 330 to 560 Brinell. The proper selection of feeds, speeds, and depths of cut appropriate for recommended tool materials and designs are important for adequate tool life and metals removal rates. Carbide tool materials best suited for use include the C-6, C-7, and C-8 grades. Ceramic tools also can be used for turning high-strength steels. One cutter design uses 5° negative rake angles, a 15° side-cutting edge angle, and 5° relief angles. High-speed-steel cutters appropriate for turning high-strength steels include the Mo-type M-2, and the Co-grade, M-15. Tungsten high-speed steel with 5% Co (T-15) seems to give the best tool life. ***C. T. Olofson.*** *Battelle Memorial Institute, Defense Metals Information Center, DMIC Memorandum* 58, July 15, 1960, 21 pages + appendix. (TN799 B32.2d Contin.)

Electroshaping: New Process Speeds Metal Removal. The new process differs from others which use the electrolytic metal removal principle. Electroshaping uses electrical energy to dislodge the surface atoms of the metal. They are swept away by a rapid and controlled flow of a chemical solution. Thus, an atom-by-atom process replaces chip-by-chip removal. Materials that are being shaped include stainless steels, hot-work tool steels, W, and Mo. ***C. L. Faust and C. A. Snavely.*** *Iron Age*, v. 186, no. 18, Nov. 3, 1960, p. 77-80.

Metal Working With Explosives. Explosive forming is a dynamic new method of metal working. Many operations such as forming, sizing, cutting, compacting, and welding can now be performed by the energy released from detonating or deflagrating an explosive. Presents a summary of activities to date and horizons opening for the future. ***John Pearson.*** *Journal of Metals*, v. 12, Sept. 1960, p. 673-681.

High Energy Rate . . . Its Application to Metal Forming. Promising the engineer unfettered design freedom, explosive, hydroelectric, and pneumatic-mechanical forming—the most important high energy rate processes for the deformation of materials—are explored. Explanation is also given to a new concept, closed-cavity extrusion molding. ***E. W. Feddersen.*** *Journal of Metals*, v. 12, Sept. 1960, p. 682-686.

* **Effect of Cutting Oils on the Operation of Nut Taps.** Studies effect of cutting oils on tap wear, torque and thread quality. Qualitative estimates are made of Russian coolants used at present in industry when tapping steel nuts. Estimates the possibility of using a new emulsion based on an oxidized petrolatum. ***I. P. Zakharenko.*** *Machines and Tooling* (Translation of *Stanki i Instrument*), v. 31, no. 6, June 1960, p. 27-30.

Manual of Machinability and Tool Evaluation. Tool-life and power-consumption formulas, cutting tests, and computation of standards, are discussed. ***Antoni Niedzwiedzki.*** 97 pp. 1960. Huebner Publications, Inc., Cleveland. (TJ1186 N55m)

How to Make Better Drawings and Stampings. Discusses the selection of forming methods, selection of the correct grade of steel, rating of stamping severity, and evaluation of the formability. ***Paul G. Nelson.*** *Metal Progress*, v. 78, no. 4, Oct. 1960, p. 85-95.

* **Present-Day Status of Chip-Formation Research.** On the basis of the results available, it becomes clear that wear is lower for alloy steels than for plain carbon steels. Carbide-forming elements, such as Cr or Mo, retard the beginning of austenite formation. There is also the very slow dissolution of carbides, and thus the austenitic phase is not rich in C, which again results in decreased wear. ***H. Opitz.*** *Microtecnic* (English Edition), v. 14, no. 4, Aug. 1960, p. 158-172.

Texture of Extruded Zirconium and Zircaloy-2 Tubing. The textures developed in extruded thin wall tubes were studied for materials fabricated by extrusion cupping and rolling. In all cases, the textures were similar with the [10.0] poles parallel to the extrusion direction. The results of burst strength tests, conducted on the extruded thin-wall tubes, and coextrusion experiments were also independent of the primary fabrication history. ***V. Nerses.*** *U. S. Atomic Energy Commission, NMI*-1222, July 11, 1960, 35 pp. (UF767 Un3.1nm Contin.)

METALS—METALLOGRAPHY, TRANSFORMATIONS, AND STRUCTURES

Crystallization From Dilute Metal Solutions. The nucleation and crystal growth from solutions of Zn in Hg were studied; the test amalgam formed one pole of a concentration cell whose e.m.f. was used as a continuous measure of the concentration. The metastable region in which spontaneous nucleation could not occur extended to 2 C below the saturation temperature. Nucleation at temperatures below the metastable region normally produced a crop of fine crystals mainly suspended in the liquid phase. ***L. Benjamin and R. F. Strickland-Constable.*** *Acta Metallurgica*, v. 8, June 1960, p. 362-372.

A Study of Solute Diffusion in Liquid Tin. The diffusion of Al, Zn, Ag, Cu and Ni in liquid Sn was investigated by the capillary-reservoir technique in a temperature range from about 240 C to 480 C. All of the solutes investigated were present in dilute solutions ranging from 0.2 to 0.7 wt.%. Discusses the results. ***C. H. Ma and R. A. Swalin.*** *Acta Metallurgica*, v. 8, June 1960, p. 388-395.

The Crystallography of the Cubic to Orthorhombic Transformation in the Alloy AuCu. The habit plane, orientation relationships and shape change were measured and are shown to conform with the phenomenological theory of martensitic transformations. The agreement with the theory is systematically better when some dilation of the habit plane is permitted. ***R. Smith and J. S. Bowles.*** *Acta Metallurgica*, v. 8, July 1960, p. 405-415.

The Thermodynamics of the Chromium-Iron System. A method for the determination of the vapor pressure of Cr was devised by combining Knudsen's effusion method with tracer analysis using Cr-51 of half-life 27.8 days. The Cr pressures in the system Cr-Fe were measured at 1340-1370 C for various compositions. ***O. Kubaschewski and G. Heymer.*** *Acta Metallurgica*, v. 8, July 1960, p. 416-423.

The Initiation of Slip in Silicon-Iron. Observations were made on the deformation of silicon-iron crystals containing small precipitates surrounded by clusters of dislocations. Slip bands were observed to develop from the clusters, and two mechanisms were distinguished. ***J. Holden.*** *Acta Metallurgica*, v. 8, July 1960, p. 424-430.

Energy of the Order-Disorder Transformation in AuCu. The heat of formation of AuCu was determined at various temperatures up to 900 K. From these and other data it was possible to establish the energy of disordering as a function of temperature. This result is discussed in terms of existing X-ray diffraction measurements of long-range and short-range order parameters for the alloy. ***R. L. Orr, J. Luciat-Labry, and R. Hultgren.*** *Acta Metallurgica*, v. 8, July 1960, p. 431-434.

Thermodynamic Analysis of Binary Liquid Alloys of Group IIB Metals. III. The Solutions of Zinc, Cadmium, Indium, Tin, Thallium, Lead and Bismuth in Mercury. The heats of solution of seven group B metals in Hg were determined calorimetrically at 150° over a fairly wide range in composition. The relative partial enthalpies of Hg were derived, and were compared with excess free energies obtained from the literature. The observed heats of formation seem to reflect the competition between an "electro-negativity" factor, which gives rise to negative terms in the enthalpy, and a "misfit" factor, which gives rise to positive terms. ***O. J. Kleppa.*** *Acta Metallurgica,* v. 8, July 1960, p. 435-445.

An X-Ray Diffraction Study of Irradiated Molybdenum. Changes in the lattice parameter, X-ray line width and microhardness of commercial Mo were observed after irradiation at 35 ± 5 C to various total fast neutron exposures from 6.5 x 10^{16} to 1.2 x 10^{20} nvt (neutrons per cm^2). The lattice parameter vs. neutron exposure curve maximizes near 5.0 x 10^{19} nvt, and at 1.2 x 10^{20} nvt a net decrease from the pre-irradiation value occurs. Both line width and microhardness increase with neutron exposure and although the microhardness approaches a limiting value with increasing irradiation, the values of line width do not. These effects in irradiated Mo are discussed from the standpoint of some recovery reactions which may occur in a reactor during irradiation and it is concluded that (1) interstitial atoms produced by neutron bombardment are mobile at the irradiation temperature, 35 C, (2) during the initial stages of irradiation a substantial number of interstitials become trapped at small substitutional impurity atoms and (3) interstitial cluster formation and growth predominates during the remainder of the irradiation. Some mechanisms of interstitial cluster formation and growth are discussed. ***D. L. Gray and W. V. Cummings, Jr.*** *Acta Metallurgica,* v. 8, July 1960, p. 446-452.

The Influence of Strain Amplitude on the Work Hardening of Copper Crystals in Alternating Tension and Compression. For a given cumulative strain, the work hardening of copper crystals in alternating straining is always less than in a tensile test. At a plastic-strain amplitude of 0.0001, the hardening is very low and nearly the same for all orientations. For larger amplitudes the behavior varies widely with orientation; in general, the rate of work hardening increases steadily with strain amplitude, but for orientations away from [110] there is a sharp increase in hardening rate above a certain amplitude. In this rapid hardening stage, prominent secondary slip is observed, which is otherwise absent. ***D. S. Kemsley and M. S. Paterson.*** *Acta Metallurgica,* v. 8, July 1960, p. 453-467.

The Contribution of Precipitation to Strain Ageing in Low Carbon Steels. In the first stage, strain aging in a low carbon steel causes atmosphere locking of dislocations, but mechanical tests showed that solute segregation beyond this first stage increases strength by a form of precipitation-hardening. A comparison of the change in lower yield stress ΔY and in electrical resistivity during strain aging shows that there is a sudden decrease in the effectiveness of solute segregation, in further increasing ΔY, at the end of the first stage. Estimates based on the Cottrell-Bilby equation suggest that this occurs at dislocation atmosphere densities not greatly in excess of one atom per atom plane. ***D. V. Wilson and B. Russell.*** *Acta Metallurgica,* v. 8, July 1960, p. 468-479.

Interactions Between Glide Dislocations in a Double Pile-Up in α-Iron. The equilibrium distribution of arrested glide dislocations on two intersecting slip planes in α-iron was computed taking into account the elastic anisotropy. From the equilibrium distribution of dislocations calculation was made of the stresses near the tip of the double pile-up (that is, a pile-up on each of two intersecting slip planes). The high stress concentration at the tip of a double pile-up indicates, as suggested by Cottrell, that such a dislocation arrangement could lead to initiation of cleavage cracks in α-iron. ***Y. T. Chou, F. Garofalo, and R. W. Whitmore.*** *Acta Metallurgica,* v. 8, July 1960, p. 480-488.

The Thermal Diffusion of Carbon in α and γ Iron. The heats of transport, Q, for carbon in α and γ iron were accurately measured for the first time. A radioactive tracer technique was used and the following values obtained. Q_e (α) = −24 ± 1.5 kcal at 700 C, Q_e (γ) ranged from −2 kcal to zero in going from 0.02% C to 0.92% C at approximately 940 C. A kinetic

treatment due to Wirtz, explains the data for Q_e (α) if it is assumed that all of the activation energy for carbon diffusion goes into preparing the lattice around the site the atom jumps into. From this satisfactory explanation of Q, it would appear that studying the effect of a temperature gradient on other simple diffusion systems would give information on the spacial distribution of the activation energy which is required before an atom can change position. ***P. Shewmon.*** *Acta Metallurgica,* v. 8, Sept. 1960, p. 605-611.

Self-Diffusion of Alpha-Iron in a Large Temperature Gradient. Experimental results of an attempt to measure the thermal gradient self-diffusion in Fe are given. A temperature gradient of 2500 C/cm was placed on each of three Fe samples for 550 hr. Platinum wire markers were placed 0.01 in. apart, normal to the sample length; the marker spacings were measured before and after the diffusion anneal. No marker shift greater than the 0.0001-in. probable error was observed; whereas marker shifts of the order of 0.001 in. were anticipated from theoretical calculations. Each of several alternative possible conclusions which may be drawn from these results are discussed: self-diffusion in α-iron is not via a vacancy mechanism, or if the vacancy mechanism predominates in α-iron, then either (a) the activation energies for formation, E_f, and migration of vacancies, E_m, are nearly equal, or (b) the role of the barrier atoms must be explicitly considered in the process of thermal activation for an atom jump in a temperature gradient, in which case the mass flow is not proportional to the difference in E_f and E_m. The model of thermal gradient self-diffusion is discussed and several experiments are suggested. In addition, a calculation is given for the dependence of thermal gradient self-diffusion on the separation of vacancy sources and sinks, using parallel grain boundaries normal to the temperature gradient as the only sources and sinks which are important. ***W. G. Brammer.*** *Acta Metallurgica,* v. 8, Sept. 1960, p. 630-636.

Phase Transformations in Cerium. The room temperature crystal structure of Ce which has not been cooled to lower temperature is face-centered cubic. The face-centered cubic structure transforms upon cooling to a hexagonal close-packed structure (c/a = 3.239) with an *ABAC* stacking sequence of close-packed planes. This transformation has many of the typical martensitic characteristics. The transformation starts at 263 ± 10 K. At 100 K, that portion of the face-centered cubic phase which has not transformed to hexagonal close-packed begins to transform to a second face-centered cubic phase with a volume decrease of 16.5%. The kinetics of this transformation also resemble that of the martensite reaction. ***C. J. McHargue and H. L. Yakel, Jr.*** *Acta Metallurgica,* v. 8, Sept. 1960, p. 637-646.

Evaporation and Thermal Etching. Measurements of the loss of weight during thermal etching of Ag were compared with estimates of the mass of Ag which would have to be removed to produce the etched structure (valley capacity). Up to about 5-hr etching time at 900 C, the two figures correspond. After this, there is little change in the valley capacity of the surface, although Ag continues to be removed at a constant rate. If net evaporation is prevented by heating the Ag in air in a Ag container, a polished surface will not become etched and an etched surface will become smooth. Thus, it is concluded that net evaporation is necessary to produce and to maintain the thermally etched structure and that the tendency to establish a minimum of surface energy is not the driving force of the process. ***E. D. Hondros and A. J. W. Moore.*** *Acta Metallurgica,* v. 8, Sept. 1960, p. 647-653.

* **State of Carbon in Liquid Cast Iron.** Tests showed that cast iron is an unequiponderant microheterogeneous system, consisting of a dispersion medium which is a saturated solution of C in Fe, and of colonies or micelles enriched with C with particle diameters of the order of 10^{-6} cm. The separation of molten cast iron during centrifugation can be treated as one of the proofs of the colloidal state of C in molten Fe. (*In Russian.*) O sostoianii ugleroda v zhidkom chugune. ***A. A. Vertman and A. M. Samarin.*** *Akademiia Nauk SSSR, Doklady,* v. 134, no. 3, Sept. 1960, p. 629-631.

* **On Changes in the Substructure of Hardened High-Speed Steel on Tempering.** Secondary hardness arises as a consequence of precipitation hardening of both primary and sec-

ondary martensite. With steel at its maximum hardness, blocks of the α-phase are equal to $1.25 \cdot 10^{-6}$ cm, while type II distortions are equal to $4 \cdot 10^{-3}$. The higher the steel hardness, the higher the concentration heterogeneity of the α-phase. (*In Ukrainian.*) Pro zminy v tonkiyi strukturi zagartovanoyi shvidkorizhuchoyi stali pry vidpusku. ***P. M. Iushkevich.*** *Akademiia Nauk Ukrains'koï RSR, Dopovidi,* 1960, no. 8, p. 1064-1069.

* **Sigma Phase in Austenitic Stainless Steels.** Austenitic stainless steels are potential fuel element canning materials for nuclear reactors operating at high temperatures. One of the principal requirements of the canning material is that it should have sufficient ductility under the operating conditions to prevent failure. Annealed, austenitic steels meet this requirement satisfactorily but the ample ductility may be reduced by the formation of an embrittling phase, termed sigma, during long periods of heating below the annealing temperature. Surveys the information available on the formation of sigma and its effects on the properties of austenitic steels. ***R. F. Hills and D. R. Harries.*** *Chemical & Process Engineering,* v. 41, Sept. 1960, p. 391-396.

A Study of the Thorium-Tungsten-Boron System. A phase diagram for the Th-W-B system was determined by X-ray diffraction of samples fired to a brightness temperature of 1800 C and furnace-cooled. A ternary compound was found with a probable composition of $ThWB_4$. This compound is monoclinic. ***Douglas T. Pitman and Dilip K. Das.*** *Electrochemical Society, Journal,* v. 107, Sept. 1960, p. 763-766.

* **Radiographic Determination of the Oxygen Parameter in Ferrites Having a Spinel Structure.** The O parameter *i* of magnesium ferrite was determined by means of the Patterson function which was equal to 0.375 ± 0.005. The diffraction picture calculated for the value *i* agreed satisfactorily with the experimental observations. (*In Russian.*) O rentfenograficheskom opredelenii kislorodnogo parametra v ferritakh so shpinel'noï strukturoï. ***V. N. Bogoslovskiï and A. A. Shchepetkin.*** *Fizika Metallov i Metallovedenie,* v. 10, no. 1, July 1960, p. 24-28.

* **Effects of Rapid Neutrons on the Properties of Metals.** Changes in the strength, hardness and electric resistance of Al, Cu, Ni, Fe, Mo, and W under the influence of rapid neutrons between 40 and 70 C were observed. The value of increase of the properties concerned as a result of radiation is determined by the crystalline structure and the melting temperature of the metal. The type of strength and hardness change depending on the integral dose differs from the type of change of the electric resistance. (*In Russian.*) O vliianii bystrykh neitronov na svoïstva metallov. ***Sh. Sh. Ibragimov and V. S. Liashenko.*** *Fizika Metallov i Metallovedenie,* v. 10, no. 2, Aug. 1960, p. 183-186.

* **Phase Transformation $\gamma \rightleftarrows \alpha$ During Aging in Steels of the 18-8 Type, Pre-Deformed During a Negative Temperature.** Secondary hardness during aging between 225 and 425 C is observed, due to the complementary formation of a magnetic phase. Further reinforcing of the steel considered can be obtained due to a subsequent aging process during one hour at about 400 C. (*In Russian.*) Fazovye prevrashcheniia $\gamma \rightleftarrows \alpha$ pri starenii v staliakh tipa 18-8, predvaritel'no deformirovannykh pri otritsatel'noï temperature. ***A. N. Chukhleb and V. P. Martynov.*** *Fizika Metallov i Metallovedenie,* v. 10, no. 2, Aug. 1960, p. 240-244.

Imperfections in Crystals. The perfect crystal, point defects in crystals, geometrical description of dislocations, mathematical theory of lattice imperfections, special properties of lattice imperfections in metallic crystals, plastic deformation of metals and production of imperfections, work-hardening of cubic crystals, interaction of dislocations with impurities, aging and hardening of alloys, annealing, polygonization and recovery, and other problems, as well as imperfections in nonmetallic crystals are discussed. ***H. G. Van Bueren.*** 676 pp. 1960. Interscience Publishers, Inc., New York. (QD931 B86i)

Second-Stage Graphitization in a Nodular Cast Iron. A study was made of the kinetic and microstructural characteristics of the graphitization of pearlite and martensite in a nodular cast iron. The decomposition of martensite invariably resulted in the formation of new nodules of graphite; a similar structure was also observed occasionally in samples initially

pearlitic. The kinetic features indicate that before the primary nodules are capable of further growth at temperatures below the eutectoid, a time-dependent nucleation process is necessary, and that the rate of growth of graphite is diffusion controlled. ***J. Burke.*** *Iron and Steel Institute, Journal,* v. 196, pt. 1, Sept. 1960, p. 42-45.

The Effect of Composition on the Structure and Properties of Martensite. It has been concluded that the major factor controlling the hardness and strength of martensite is the amount of C in solid solution. Alloy elements have little effect on the martensite structure, but mainly affect the tempering process, retarding carbide precipitation and maintaining the high martensitic hardness to higher temperatures. The mechanical properties of plain carbon martensite are most satisfactory with between 0.3 and 0.5% C and when tempered at 200-300 C. Alloy steels at any particular strength level have better ductility and also very much better impact properties, particularly when molybdenum is present. This appears to be due to a modification of carbide precipitation so that films at martensite plate boundaries are eliminated. ***K. J. Irvine, F. B. Pickering, and J. Garstone.*** *Iron and Steel Institute, Journal,* v. 196, pt. 1, Sept. 1960, p. 66-81.

* **Precipitation Phenomena and Properties of AlZnMg-Alloys.** In aluminum alloys containing about 5% Zn, 1% Mg, and 0.2% Cr or Mn, at least three types of precipitates causing hardening were observed; Guinier-Preston zones, metastable η-phase, and stable T-phase. A survey was made of our present knowledge of these precipitates and their influence on the properties of the material. (*In Swedish.*) Utskiljningsmekanism och egenskaper hos Al-Zn-Mg-legeringar. ***E. Lindstrand.*** *Jernkontorets Annaler,* v. 144, no. 6, 1960, p. 432-443.

On the Formation of Intermediate Phases in Alloys of Nb, Ta, Mo and W With Other Transition Metals. Describes certain phases found in transition metal alloys. The type of structure formed, and the manner in which the various atomic sites are occupied, are interpreted in terms of atomic size and valency effects. ***C. W. Haworth.*** *Journal of the Less-Common Metals,* v. 2, nos. 2-4, Apr.-Aug. 1960, p. 125-130.

Effect of Hydrogen on Dislocation Locking in Niobium. The strain-aging tendencies of as-received commercial purity arc-melted Nb and hydrogenated Nb from the same heat were investigated using yield point return and dynamic modulus measurements to study the aging process. Comparison of activation energies for strain aging with those for interstitial diffusion revealed that H could be responsible for dislocation locking in Nb. ***B. A. Wilcox and R. A. Huggins.*** *Journal of the Less-Common Metals,* v. 2, nos. 2-4, Apr.-Aug. 1960, p. 292-303.

* **Diffusion of Metals in Aluminum.** To obtain data on the speed of diffusion of alloy constituents in Al and on their reciprocal influence, binary aluminum alloys with 1 or 3% Cu, Mn, Mg, Si, Fe, Zn, and Cr were plated with Al or with one another and coefficients of diffusion were determined. Diffusion diagrams were plotted. (*In German.*) Über die Diffusion von Metallen in Aluminium. ***W. Roth.*** *Metall,* v. 14, Oct. 1960, p. 979-983.

* **Studies on Platinum Base Alloys in Platinum-Molybdenum System.** The maximum solubility limit of Mo in α-phase (Pt-phase) is 15 wt%. Cold working can be applied to α-phase alloys which contain less than 6 wt% of Mo, and whose annealing temperature is above 1100 C. ***Hirozō Kimura.*** *National Research Institute for Metals, Transactions,* v. 2, no. 1, 1960, p. 30-36.

On Dislocations Formed by the Collapse of Vacancy Discs. The formation of dislocations by the collapsing vacancy disc mechanism was examined for Al, Cu, Si, and Ge. It is shown that this mechanism can be important in the case of metals. In the case of Si and Ge, dislocation loops produced by the above mechanism, during usual crystal growth from the melt, will not reach sizes detectable by means of the optical microscope. ***C. Elbaum.*** *Philosophical Magazine,* v. 5, ser. 8, July 1960, p. 669-674.

Etching of Strained Aluminium. The initiation of etch attack of strained Al was studied by optical and electron microscopy. It is concluded that an important factor is rupture of the protective natural oxide film and its subsequent failure to repair

completely in a short time. A deformation in compression appears to damage the oxide film more severely than deformation in tension. ***G. A. Bassett and C. Edeleanu.*** *Philosophical Magazine*, v. 5, ser. 8, July 1960, p. 709-716.

Thermally Activated Point Defect Migration in Copper. Presents a recovery model which includes specific assignments of point defect migration to the various recovery stages in Cu. New experimental results show the effects of prior cold work on the production and subsequent recovery of damage produced in Cu by 10 K and 90 K electron irradiations. The most significant observations in these experiments were: irradiation recovery Stages I_D and I_E are suppressed by previous cold work; this suppression is reflected in an increased damage rate at 90 K; additional damage which remains in Stages I_D and I_E, or which is produced at 90 K, recovers in Stage III; the recovery in Stage III is altered from the bi-molecular process characteristic of annealed Cu; under certain conditions a super-recovery occurs in Stage III so that the measured resistivity drops below the pre-irradiation value. These observations are interpreted according to this recovery model. ***C. J. Meechan, A. Sosin, and J. A. Brinkman.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 411-419.

Order-Disorder Phenomena in α-Brass. I. Development of Order. II. Influence of Quenching. III. Influence of Plastic Deformation. Observes an absorption of energy of 0·40 cal/g in the range of temperature 180-245 C on heating a slowly cooled specimen of α-brass at 2 C/min. This absorption of energy increases markedly on isothermal annealing at temperatures below 190 C; the maximum absorption being 0·86 cal/g. The absorption of energy is correlated with changes in electrical resistivity and the results of the energy and resistivity measurements are attributed to the destruction of order. The transformation from disorder to partial order which occurs during slow cooling α-brass may be suppressed by quenching. Results indicate that specimens quenched from 600 C reorder rapidly below 160 C to a higher degree of order than that in slowly cooled specimens. For specimens quenched from 300 C the initial degree of disorder is greater and reordering slower. No changes in hardness are found to accompany reordering in quenched specimens. The evolution of stored energy during heating for specimens of deformed α-brass is quite different from that previously observed for pure metals; the stored energy is much larger and at least three stages of evolution exist. The large release of energy in the first two stages is attributed mainly to the return of order destroyed by plastic deformation. Reordering is complete before the beginning of the third stage of further recovery and recrystallization, in which dispersal of atmospheres is again important. I. ***L. M. Clarebrough and M. H. Loretto.*** II-III. ***L. M. Clarebrough, M. E. Hargreaves, and M. H. Loretto.*** *Royal Society, Proceedings*, v. 257, ser. A, Sept. 20, 1960, p. 326-385.

Thermal Diffusion of Hydrogen in Nonstoichiometric Zirconium-Dihydride. Measurements on the magnitude and direction of the Ludwig-Soret effect in Δ-phase ZrH_x in the temperature range 1000-1300 F were made. The "heat of transport", Q^*, of H in ZrH_x was determined to be 1.3 ± 0.4 kcal/mole. A mathematical analysis of the kinetics of H redistribution compares favorably with experimentally-observed results. A similarity in the magnitude of Q^* and ΔH, enthalpy of solution, was noted. ***A. W. Sommer and W. F. Dennison.*** *U. S. Atomic Energy Commission, NAA-SR-5066*, Oct. 1, 1960, 27 pp. (UF767 Un3.1na Contin.)

METALS—POWDER

Nitrides, Carbonitrides and Oxynitrides of Niobium. Methods of preparing niobium nitrides and oxynitrides are described. The stability of the different phases were thoroughly investigated. A survey of the carbonitrides of Nb is given and some of their properties are described. ***G. Brauer.*** *Journal of the Less-Common Metals*, v. 2, nos. 2-4, Apr.-Aug. 1960, p. 131-137.

Vacuum Sintering. Reviews advantages, pumping and heating equipment, vacuum gages, and applications. ***F. G. Cox.*** *Metal Industry*, v. 97, Sept. 16, 1960, p. 231-232.

The Rolling of Copper Strip From Hydrogen-Reduced and Other Powders. Copper powders were rolled to form strip in a normal two-high mill. Satisfactory green strip was obtained from the low-density powder produced by hydrogen reduction from aqueous solution, provided that a mechanical method was used to feed the powder into the rolls. All the types of powder investigated required considerable further rolling after compaction, with at least two heat treatments, to produce normal mechanical properties. ***D. G. Hunt and R. Eborall.*** *Powder Metallurgy*, no. 5, 1960, p. 1-23.

Some Mechanical Requirements of Plant for the Roll-Compacting Process. Defines the duty required of the plant, and discusses the type of mill necessary and the various systems used for dispensing powder in relation to operational requirements. The process of roll compacting and the resulting strip conditions are discussed in relation to the variables in physical dimensions of plant and product. It is considered that roll loads as given by some investigators may be higher than those actually obtained in practice, and some explanation of this claim is given. Brief reference is made to the lubrication of the rolls or the powder during the compacting process and to subsequent processes, including sintering, densification, and cold rolling. ***A. F. Marshall.*** *Powder Metallurgy*, no. 5, 1960, p. 24-31.

Continuous Compaction by Cyclic Pressing. A process recently developed produces wide, thick bars of unlimited length from powder, granular, or sponge raw materials by a cyclic pressing operation. The process can be adapted readily for laboratory study or for large-scale production. Many materials have been pressed by this technique, and in all cases compaction was similar to that experienced in conventional pressing. Work on the pressing, sintering, and subsequent working of various nickel powders and of a nickel-iron-molybdenum magnetic alloy was carried out. Carbonyl nickel powder produces nickel strip of high quality. A high-permeability alloy containing nickel 79, iron 17, and molybdenum 4% can be made into strip with good magnetic properties by compacting the powders with the cyclic-pressing technique and then sintering and rolling the pressed bar into strip. ***C. Deibel, D. R. Thornburg, and F. Emley.*** *Powder Metallurgy*, no. 5, 1960, p. 32-44.

The Formation of Uranium and of Beryllium Alloys by the Solid-State Sintering of Mixed Elemental Powders. Large volume expansions accompany the formation of binary alloys of Be with U, Th, Fe, Cu, Zr, Ti, and V, and of U with Al, during the sintering of the mixed, cold-compacted elemental powders. No expansion was detected during the sintering of binary mixtures of Be with Al, Si, and Mg, or mixtures of U with Zr, Mo, Fe, Ni, Mn, and Cr. When it occurs, expansion is anisotropic, being greatest in the direction of compacting; the degree of anisotropy varies with the constituents and the composition of the alloys. In systems undergoing expansion, the volume expansion/composition graphs exhibit maxima. For a given system, the magnitude of the maximum is a function of the shape of compact, the particle size of the powders, and the sintering time and temperature; the composition at which the maximum occurs is sensibly unaffected by these latter variables. ***J. Williams and J. W. S. Jones.*** *Powder Metallurgy*, no. 5, 1960, p. 45-63.

Metal-Ceramic Mixtures. The present position regarding cermets based on either oxides or carbides as the brittle phase is reviewed. The outlook for oxide systems is to some extent disappointing, since little gain in strength has been found compared with the oxide itself. Oxide cermets do, however, show an intermediate improvement in thermal shock resistance that is useful in a number of directions. Carbide cermets appear adequate for many high-duty applications so far as thermal shock-resistance is concerned, but improvements in their resistance to mechanical shock are still necessary. Recent work on ductile ceramics is also reviewed, and the importance of carrying out experiments at high strain rates is emphasized. Finally, suggestions are made for further work in the field of cermets. ***P. Murray.*** *Powder Metallurgy*, no. 5, 1960, p. 64-80.

Sintered Stainless Steel. I. The Influence of Alloy Composition Upon Compacting and Sintering Behaviour. II. The Properties of Stainless Steel Powders Sintered in Dissociated Ammonia. ***R. L. Sands and J. F. Watkinson.*** *Powder Metallurgy*, no. 5, 1960, p. 85-115.

Textures in Beryllium Rods and Tubes Extruded From Consolidated Powder. Textures in Be rods and tubes extruded from consolidated powder were studied by X-ray diffraction techniques. The temperature of extrusion has little effect on the texture, but the extrusion reduction determines which of two main types of texture is developed in tubes. In low-reduction textures ($\leq$ 6:1), the basal planes tend to concentrate parallel to the surface of the tube; in high-reduction textures ($\geq$ 12:1), the basal planes still lie parallel to the extrusion direction, but tend to concentrate at angles ranging from 45-90° to the surface. A prism-plane fiber texture is present in all tubes. The deformation mechanisms possibly responsible for these textures are discussed. ***N. A. Hill and J. Williams.*** *Powder Metallurgy*, no. 5, 1960, p. 116-129.

The Compacting of Graphite and Graphite/Uranium/Thorium Mixtures. Fine artificial graphite powders can be cold compacted to give bodies of high density (~88% of theoretical), low permeability ($B_0 \sim 10^{-14}$ cm^2), and reasonable strength. Such powders, after vacuum annealing, will not compact. Die-compacted powder has strong anisotropic properties owing to a high degree of preferred orientation within the compact; this effect is less marked in hydrostatically compacted powder. Minor dimensional changes occur when compacts are annealed in the range 600-1000 C. The preparation of fuels by incorporation of fissile and fertile materials into graphite powder and cold compacting is described. ***D. T. Livey, I. Denton, N. Brett, and J. Williams.*** *Powder Metallurgy*, no. 5, 1960, p. 130-148.

The Continuous Sintering of Copper-Lead to Steel. Bimetal strip consisting of Cu-Pb bonded to steel is produced by sintering uncompacted powder onto the steel, compacting by rolling, and resintering. The mechanism of the process is considered in the light of published work on liquid-phase sintering and of some experiments in which material at various stages of processing has been examined physically and metallographically. It is concluded that the process differs from normal liquid-phase sintering in that interparticle welding is brought about by the intermediate rolling process. ***P. G. Forrester and J. K. Beddow.*** *Powder Metallurgy*, no. 5, 1960, p. 149-154.

Sintered Nickel Steels. I. By the addition of only 3.5% Ni and less than 0.75% C to Fe powder, a heat-treatable alloy can be produced. This material, as heat-treated, has an ultimate tensile strength in excess of 100,000 psi, an elongation of about 2%, and a Rockwell C hardness of from 30 to 40. ***Walter V. Knopp.*** *Precision Metal Molding*, v. 18, Sept. 1960, p. 55-61.

Preparation of Self Bonded Borides. Self bonding of metal boride powders was achieved by hot pressing the powders to high density at high temperature. Density, grain size and hardness data were obtained. In some cases where two or three boride phases were initially present in the powder, the hot pressed sample appeared only single phase in metallographic and X-ray diffraction analysis. ***Earl W. Hoyt and Juan Chorne'.*** *U. S. Atomic Energy Commission, GEAP-3332*, June 6, 1960, 15 pp. (UF767 Un3.1gea Contin.)

NONDESTRUCTIVE TESTING AND QUALITY CONTROL

*** The Economic Incentive Provided by Sampling Inspection.** Considers two aspects of sampling inspection—the curative and the incentive. Discusses the importance of the incentive aspect and indicates a possible line of approach to a theory of sampling inspection which takes this aspect into account. ***I. D. Hill.*** *Applied Statistics*, v. 9, no. 2, June 1960, p. 69-81.

*** Helium Leak Testing Fuel Rods for the PWR Blanket.** ***A. E. Oaks.*** *Nondestructive Testing*, v. 18, no. 5, Sept.-Oct. 1960, p. 319-322.

*** Nondestructive Testing of Hardware for Solid Rocket Motors.** ***S. M. Joseph.*** *Nondestructive Testing*, v. 18, no. 5, Sept.-Oct. 1960, p. 315-318.

*** A New Tool for Steelmaking: Man-Made Atoms.** ***John Carlson and A. Eugene Frey.*** *Western Metalworking*, v. 18, Sept. 1960, p. 36-38.

NUCLEAR PHYSICS, NUCLEONICS, AND RADIATION

*** Spin-Orbit Splitting and Tensor Force.** Calculates the second-order effect of the tensor force in nuclei which have several nucleons outside closed shells. This second-order effect causes a modification of the first-order secular equation of the degenerate shell-model states $(nl)^p$, where nl is an orbit of the L-S coupling shell model and p is the number of nucleons outside closed shells. In this numerical calculation, the harmonic-oscillator wave functions are adopted as individual wave functions, and either the tensor force suggested by meson theory or the phenomenological strong tensor force is assumed. If the three-body effect is neglected, the modified secular equation results in the intermediate-coupling shell-model Hamiltonian, provided that the two-body effective potential is replaced by the usual potential which has the same matrix elements as the effective one. ***Akito Arima.*** *Nuclear Physics*, v. 18, no. 2, Aug. 1960, p. 196-223.

*** Neutrino and Cosmology.** The elementary relativistic cosmological model is refined by taking into account the proper motions of particles. It is found that the latter were in the past much faster than now, and it is thereby inferred that there must actually exist, in our Universe, a large population of low-energy neutrinos, due to previous high-energy nuclear reactions. It is shown how these neutrinos can be detected through their gravitational influence. In case they fail to be detected, it must be concluded that there exists a possibility of annihilation of neutrino-antineutrino pairs. ***Asher Peres.*** *Progress of Theoretical Physics*, v. 24, no. 1, July 1960, p. 149-154.

*** A Possible Interpretation of High Energy Nuclear Events.** Proposes a method of analyzing the data of high-energy jet showers in nuclear emulsions. Discusses the possibilities to reduce the nucleon-nucleon collisions to pion-nucleon interactions. If the experimental data on π^--p collision at 5 Gev as the pion-nucleon interaction is used, the energy and angular distribution of emitted pions can be estimated in rather low-energy jet showers (~ 100 Gev) and the obtained results fairly agree with the experiments. As to the high-energy jet showers (~ 100 Gev), it can be concluded that almost all collisions are regarded as peripheral ones and that the properties of the pion-nucleon interaction reduced from the nucleon-nucleon collision are similar to those of the pion-nucleon interaction actually observed. It is also suggested that the nucleon has a core whose radius is about a nucleon Compton wavelength. ***Nobuo Yajima, Shuji Takagi, and Keiso Kobayakawa.*** *Progress of Theoretical Physics*, v. 24, no. 1, July 1960, p. 59-80.

Liquid Metal Fuel Reactor Experiment. Quarterly Technical Report, May 1957-September 1957. Research and development coordination, physics and mathematics, reactor engineering, systems engineering, mechanisms engineering, chemical processing, materials testing, prototype testing, instrumentation, remote maintenance, radiation loop testing, reactor building, remodeling existing buildings, site development, and other services are discussed. *U. S. Atomic Energy Commission, BAW-1033*, 1957, 75 pp. (UF767 Un3.1ba Contin.)

*** Some Theoretical Properties of the Double-Crystal Spectrometer Used in Neutron Diffraction.** A treatment is given of the angular dependence of certain intensity functions which are important in spectrometer design. It provides a basis for the choice of various parameters, including, in particular, the Bragg angle of the crystal monochromator. ***B. T. M. Willis.*** *Acta Crystallographica*, v. 13, pt. 10, Oct. 10, 1960, p. 763-766.

A Method for the Comparative Evaluation of Reactor Control Materials. Describes a method of comparing the approximate nuclear worth and reactivity life of various neutron absorber materials. The method is applicable to thermal reactors with slab type control elements. It is not suitable for comparing control materials when used in rectangular or cylindrical rod geometries. ***T. J. Pashos, G. D. Ritland, and J. L. Russell, Jr.*** *U. S. Atomic Energy Commission, GEAP-3344*, Apr. 13, 1960, 13 pp. (UF767 Un3.1gea Contin.)

A Survey of New Cadmium Materials for Possible Reactor Application. A general survey of the literature was made to discover new Cd- bearing materials for more effective and more economical control rods in nuclear reactors. The fields of

chemistry, metallurgy and ceramics were explored and several promising materials and/or fabrication techniques are indicated. Generally speaking, all of the work recommended for experimental investigation can be accomplished with existing facilities at Vallecitos Atomic Laboratory or with the acquisition of minor items of equipment. ***S. Siegel.*** *U. S. Atomic Energy Commission, GEAP-3395*, Apr. 1, 1960, 19 pp. (UF767 Un3.1gea Contin.)

Preliminary Results on a Source of Monochromatic Photons Produced by Annihilation in Flight of Positrons (1960). An experiment is described in which monochromatic photons are produced by annihilation in flight of relativistic positrons obtained from the beam of electrons leaving a linear accelerator. The preliminary results show that, in accordance with expectations, this process makes it possible to obtain in practice a source of photons with a narrow spectrum and variable energy. (*In French.*) Résultats préliminaires sur une source de photons monochromatiques produits par annihilation en vol de positons. ***Jacques Miller, Claude Schuhl, Gabriel Tamas, and Christophe Tzara.*** *France, Commissariat a l'Énergie Atomique, Rapport CEA No.* 1469, 1960, 3 pp. (QC770 F84.2r Contin.)

Interpretation of γ-Ray Scintillation Spectra From Fission-Product Mixtures. γ-Ray scintillation spectra are calculated for the products of simultaneous slow neutron fission of U 235. These theoretical spectra serve as a basis for comparison with practical measurement of fission-product mixtures. The variation with time, from 1 to 28 days, of the photoelectric peak height is shown for the prominent fission product activities. A rapid method of half-life analysis is described for use when peaks are inadequately resolved in energy. The effect of spectrometer resolution is discussed. ***D. H. Peirson.*** *British Journal of Applied Physics*, v. 11, Aug. 1960, p. 346-353.

* **Bismuth in Nuclear Engineering.** Homogeneous reactors using liquid metals as solvents for fissionable materials were studied, especially considering Bi as a solvent, its production, properties, corrosion behavior, and thermal transfer capacity in the molten state. (*In German.*) Wismut in der Kerntechnik. ***W. Mialki.*** *Metall*, v. 14, Sept. 1960, p. 863-867.

* **The Army's Nuclear Power Program.** Discusses training of nuclear-reactor crews, nuclear-powered overland train, nuclear-powered combat vehicles. ***John P. Tyler, III.*** *Army*, v. 11, no. 3, Oct. 1960, p. 27-31.

* **An Improved Approximation for Scattering Problems.** A method for calculating the scattering phase-shift in atomic and nuclear collision problems is developed. In the limit of high collision energies, the method reduces to a second Born approximation for the phase-shift and for low energies to the shape-independent formula. The accuracy attained is an order of magnitude better than the first or second Born approximations, due to the distortion of the wave function of the scattered particle by the potential well being allowed for in a simple manner. The method applied over the whole range of energies and involves one extra integral besides the first Born approximation integral. No multiple integrals are needed as in higher Born approximations. ***P. Swan.*** *Nuclear Physics*, v. 18, no. 2, Aug. 1960, p. 245-270.

* **Reactor Core Materials.** A review of recent developments. *Reactor Core Materials*, v. 3, no. 3, Aug. 1960, 60 pp.

* **Containment Vessels for Reactors BR II and BR III at Mol.** The design, construction, erection and testing of the pressurized containment vessels for the BR II and BR III reactors at the Belgian Nuclear Energy Research Centre at Mol are described. The BR II is a materials testing reactor of very high flux. The BR III is a PWR type (pressurized-water power reactor) with a very low power output of 11,500 kw. ***G. Herzet, P. Laval, and G. Martelée.*** *Nuclear Energy*, Sept. 1960, p. 403 + 5 pages.

Radiation Effects on Reactor Metals. Discusses radiation effects on carbon steels, stainless steels, Zr, Al, Be, and Mo. Irradiation experiments with all types of reactor materials must continue so as to reduce the "ignorance factors" now going into component designs. ***David O. Leeser.*** *Nucleonics*, v. 18, Sept. 1960, p. 68-73.

* **Dragon—A Joint European Nuclear Research Reactor.** The Dragon high-temperature gas-cooled reactor now under construction at the U.K. Atomic Energy Establishment, Winfrith, is a joint project of 12 European countries, under the auspices of the O.E.E.C. *Overseas Engineer*, v. 34, Sept. 1960, p. 38-39.

a

On the Measurement of Orbital Electron Capture With Particular Reference to ^{131}Cs. A scintillation counter method, which eliminates the need for escape corrections, was developed for the measurement of L/K capture ratio for intermediate and high Z nuclei. With this method the L/K capture ratio was determined for ^{131}Cs at 0.153 ± 0.008. ***B. R. Joshi and G. M. Lewis.*** *Physical Society, Proceedings*, v. 76, pt. 3, Sept. 1960, p. 349-354.

b

Shadow Effect in the Scattering of GeV Pions and Nucleons by Deuterons. The experimental total cross sections for the individual pion-nucleon and nucleon-nucleon processes were used to deduce the pion-deuteron and nucleon-deuteron total cross sections using a geometrical optic model. ***B. Dejon and K. Smith.*** *Physical Society, Proceedings*, v. 76, pt. 3, Sept. 1960, p. 346-348.

c

Vacuum Polarization Effects on Energy Levels in μ-Mesonic Atoms. The shifts of the energy levels of μ-mesonic atoms due to vacuum polarization are calculated for the states $n = l + 1$. The first-order perturbation integrals are evaluated both in closed form and by means of series expansions. A more accurate calculation of the energy shifts which takes into account the alteration of the atomic wave functions by the vacuum polarization potential is described. ***Roy Glauber.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 609-613.

d

* **Compact Reactors.** The operation of compact reactors is discussed in general. A variation of the pressurized water reactor which shows promise of reducing both fuel and capital costs is the Spectral Shift Control Reactor. The "built-in" excess reactivity in the PWR core to achieve long life is balanced out by modifying the neutron spectrum so that the resonance absorption in the fertile material is markedly increased. It is estimated that a given PWR primary reactor system can produce 70% more power when operated as a SSCR, due to the improved power density. *Engineering*, v. 190, Sept. 16, 1960, p. 383-384.

e

Safe Design of In-Pile Tests. Discusses safety evaluation, excessive temperature, component failure, reactivity changes, chemical explosions, safe design as eliminating hazards, and simultaneous safeguards. An over-instrumented safety system can repeatedly shut down the reactor and interrupt all experiments because of instrument failures. ***Theodore Beresovski.*** *Nucleonics*, v. 18, Sept. 1960, p. 106 + 7 pages.

f

Small Size Pressurized Water Reactor Conceptual Design. *U. S. Atomic Energy Commission, TID-8526*, June 1960, 81 pp. + figures. (UF767 Un3ti Contin.)

g

The Production of Antinucleons by Pions. The reactions $\pi^- + p \rightarrow \bar{p} + p + n$ and $\pi^- + p \rightarrow \bar{p} + d$ were investigated. The calculations are based on third-order perturbation theory with pseudoscalar coupling between nucleons and pions and with a phenomenological treatment of the nucleon-nucleon interaction in the final state. Gives cross sections in graphical form for the above reactions and for the transitions between eigenstates of isotopic spin. The final-state nucleon-nucleon interaction is shown to have a large effect on the cross sections. The total cross section for the reaction leading to the unbound final state is calculated by assuming a modified Fermi statistical model. At an energy 100 Mev above threshold, this cross section is approximately 0.1 mb. A theoretical expression for the transition amplitude is developed. ***Owen C. Eldridge, Jr.*** *U. S. Atomic Energy Commission, UCRL-9128*, June 7, 1960, 92 pp. (UF767 U3u Contin.)

h

i

j

* **Instrumentation and Control of Nuclear Power Plants.** Practical tips for designing a supersafe control system to handle reactor startup and abnormal operating conditions. ***C. F. Obermesser.*** *Chemical Engineering Progress*, v. 56, Sept. 1960, p. 60-65.

k

Pion-Pion Interaction in Electromagnetic Processes. The correction to the photon propagator due to the emisison of a virtual pion pair is evaluated, taking into account the effect of

the strong pion-pion interaction in the $J = 1$, $T = 1$ state of the pions recently discussed by several authors. Results are given for different sets of parameters describing the pion form factor, and the possibility of investigating the structure of the form factor by means of electron-electron and electron-positron collision experiments is studied. ***Laurie M. Brown and Francesco Calogero.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 653-658.

K-Electron Excitation Accompanying K Capture in Cs^{131}. The probability of production of an atom with a completely vacant K shell by excitation of the second K electron during the K-electron capture process was determined to be $(2.5 \pm 0.2) \times 10^{-5}$ per K-capture event in Cs^{131}. A scintillation coincidence spectrometer with a coincidence resolution time of ten millimicroseconds for 30-kev X-rays was used for the measurement. The half-life of Cs^{131} was redetermined to be 9.69 ± 0.05 days. Previous measurements of electron excitation phenomena accompanying K capture are summarized, and the results are compared with the theory of Primakoff and Porter. ***N. L. Lark and M. L. Perlman.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 536-542.

Proposal for Measuring the π^0 Lifetime by π^0 Production in Electron-Electron or Electron-Positron Collisions. The cross section for production of π^0 mesons by colliding electrons is calculated in the virtual photon approximation. This cross section is directly proportional to the inverse π^0 lifetime, and the proportionality constant is independent of the strong couplings. For a center-of-mass energy of 300 Mev and a π^0 mean life of 10^{-18} sec. the total cross section is about 10^{-33} cm^2. ***F. E. Low.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 582-583.

Imaginary Part of the Delbrück Scattering Amplitude. A method for computing the imaginary part of the Delbrück scattering amplitude, based on an expression derived by Kessler, was developed and applied for γ-ray energies of 2.62 and 6.14 Mev. The significance of the calculation with regard to available experimental results is discussed, and some possible further developments are outlined. ***W. Zernik.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 549-551.

Fission of Radium by 11- to 22-Mev Protons. The ranges and relative yields of Sr^{91} and Pd^{112} fragments from the fission of Ra^{226} by 11- to 22-Mev protons were determined by a radiochemical recoil-catching technique. The relative yield data indicate that above 11 Mev the three-humped mass-yield curve becomes predominantly "symmetric", and perhaps somewhat narrower. An apparent fission threshold of ~ 10.4 Mev was observed. The curve of total fission yield vs energy has the same slope between 13 and 22 Mev as has been reported for the fast-neutron-induced fission of radium. The ranges in mg Au/cm^2 at 11 and 20 Mev, respectively, are, Sr^{91}: 11.2 ± 0.9 and 10.8 ± 0.2; Pd^{112}: 9.1 ± 1.0 and 9.2 ± 0.3, corresponding to an average total kinetic energy of 162 ± 10 Mev. ***Robert L. Wolke.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 543-548.

Neutron Total Cross Sections in the 17- to 29-Mev Region. The neutron total cross sections of 42 elements and isotopes were measured at several energies between 17 and 29 Mev, using monoenergetic neutrons produced by the Livermore variable-energy cyclotron through the $T(d,n)He^4$ reaction. Beam contaminations by γ-rays and low-energy "breakup" neutrons were measured by time-of-flight techniques, and their effects were kept small by suitably high bias on the plastic scintillator detector. The accuracy in cross section is typically ± 1 to 2%. The data in this energy region have been sparse, but where comparisons with previous data are possible, there is substantial agreement. ***J. M. Peterson, A. Bratenahl, and J. P. Stoering.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 521-526.

$Be^9(\alpha,n)C^{12}$ Reaction and the Parameters of the 7.66-Mev State of C^{12}. The $Be^9(\alpha,n)C^{12}$ reaction was studied at $\bar{E}_\alpha = 5.6$ and 5.78 Mev. Neutron groups were observed to the first three states of C^{12}. The ratio of the population of the 4.43- and 7.66-Mev states was determined to be 8.1 ± 1 at $\bar{E}_\alpha = 5.6$ Mev. This value, together with information from a number of other sources, demonstrates that the 7.66-Mev state has $J\pi = 0^+$, that its width for α emission is approximately the Wigner limit ($\tau \sim 8$ ev) and that in $\sim 10^{-4}$% of the cases the state decays to the ground state of C^{12} by pair emission. It is also estimated that the 7.66-Mev state can decay by γ emission via the 2^+, 4.43-Mev state with a probability of 1/5000. This information reinforces the proposal that the 7.66-Mev state has the necessary properties to participate in the buildup of the elements in red giant stars. ***F. Ajzenberg-Selove and P. H. Stelson.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 500-504.

Experimental Study of the Mechanism of (p,t) Reactions at 22 Mev. Energy distributions of tritons from various elements throughout the periodic table show prominent peaks which can be identified with states in the residual nucleus which result from the removal of two neutrons from single-particle states in the target. This is indicative of a double pickup mechanism for the (p,t) reaction at this energy. The use of this reaction in identifying the position and character of single-particle levels is illustrated. The reaction is also used to determine the mass of Ru^{101}. ***J. B. Ball and C. D. Goodman.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 488-491.

Electroproduction of Pions From Hydrogen and Deuterium. The absolute cross section for direct production of pions in electron-proton and in electron-deuteron collisions was measured by the detection of inelastically scattered electrons. Proton data were taken throughout the range of $q^2 = 2.6$ f^{-2} to $q^2 = 10.75$ f^{-2}, and center-of-mass energy $E = 1100$ Mev to $E = 1300$ Mev. Data analysis was in terms of a neutron magnetic moment distribution. Comparison with available theory yields a neutron rms magnetic moment of 1 f, but better theoretical calculations may change this value somewhat. The deuteron data are presented in terms of absolute cross sections as well as in terms of a deuteron-proton cross-section ratio. ***Gerald G. Ohlsen.*** *Physical Review*, v. 102, 2nd ser., no. 2, Oct. 15, 1960, p. 584-592.

* **An Experimental Study of the Oscillation of Electrons in Cyclic Accelerators.** Experience shows that the real radiation loss occurs more slowly than the theory would require. Above 400 Mev in the synchrotron S-60, apparently there is an important quantum oscillation amplitude. There is sustained vibration in "z", of unknown origin. At the end of the cycle of acceleration there is a coupling of the radial and vertical oscillations. (*In Russian.*) Eksperimental'noe issledovanie kolebaniĭ elektronov v tsiklicheskikh uskoriteliakh. ***F. A. Korolev, A. G. Ershov, and O. F. Kulikov.*** *Akademiia Nauk SSSR, Doklady*, v. 134, no. 2, Sept. 1960, p. 314-317.

Radiological Decontamination. Theoretical and Practical Aspects. The factors involved in the adsorption of radio isotopes on non-metallic surfaces include ion exchange, physical adsorption and direct penetration, although in many cases "surface films" act as barriers. On metallic surfaces, contaminants appear to be bound by adsorption on oxide films or by exchange with the metal itself. The method of removal must be related to the mechanism by which the contaminant is held, but may be broadly classified as detergency, ion displacement, and surface removal. ***D. G. Stevenson.*** *Research Applied in Industry*, v. 13, Oct. 1960, p. 383-389.

* **Measurement of the Slow Neutron Spectrum of a Neutron Beam From the WWWRS Reactor by Means of a Crystal Neutron Spectrometer.** The efficiency of a crystal neutron spectrometer was determined experimentally using a double crystal arrangement. On the basis of these results the slow neutron spectrum of a neutron beam was determined in the range of neutron wavelength 0.5-2.5 Å. The variation of crystal reflectivity with wavelength was compared with a theoretical expression for this dependence. ***D. A. O'Connor and J. Sosnowski.*** *Acta Physica Polonica*, v. 19, no. 3, 1960, p. 329-338.

The Radiological Assessment and Recovery of Contaminated Areas. A test was conducted on D + 1 and D + 2 days after shot Coulomb C. Data were obtained on reclamation of land areas by scraping with a motorgrader, on fire-hosing and scrubbing a concrete-slab roof, and on fire-hosing a composition roof. The decontamination effectiveness in terms of the fraction of contamination remaining was computed to be: 0.2 to 0.3 for scraping with a motorgrader, 0.3 to 0.4 for fire-hosing

a concrete roof, and 0.3 to 0.4 for fire-hosing a composition shingle roof. Higher levels of fallout, in terms of the fallout particle mass, are required to obtain useful information and training on decontamination techniques. ***Carl F. Miller.*** *U. S. Atomic Energy Commission, CEX-57.1,* Sept. 28, 1960, 68 pp. (UF767 Un3.1cex Contin.)

Cost Study of a 100-Mw(e) Direct-Cycle Boiling Water Reactor Plant. ***C. F. Bullinger and J. M. Harrer.*** *U. S. Atomic Energy Commission, ANL-6178,* July 1960, 98 pp. (UF767 Un3.1an Contin.)

* **The Design and Applications of a Demountable 4π Geiger-Müller Counter.** An improved 4π G.M. counter has been designed from which the cathode can be easily removed, leaving the anode wires intact and still under tension. Counters of this type have been used successfully for several years in the measurement of radioactive nuclide standards and results of intercomparisons of standards with other laboratories are presented. Applications of these counters in biological and medical work are described. ***L. K. Burton and N. G. Trott.*** *International Journal of Applied Radiation and Isotopes,* v. 8, no. 1, May 1960, p. 20-28 + 1 plate.

Measurement of the Temperature Dependence of Neutron Diffusion Properties in Beryllium Using a Pulsed Neutron Technique. The pulsed technique consists of introducing a short pulse of neutrons into a volume of the material under study, waiting for a sufficient length of time for the neutrons to thermalize and reach a normal mode distribution, and then measuring the decay rate of the normal mode density distribution. The decay constant is a function of the neutron absorption in the material and leakage from the volume. ***Warren M. Andrews.*** *U. S. Atomic Energy Commission, UCRL-6083,* Aug. 1960, 232 pp. (UF767 U3u Contin.)

* **The Efficiency Tracing Technique for Eliminating Self-Absorption Errors in $4\pi\beta$-Counting.** Examines in detail the validity of a standardization technique recently described by Merritt et al., in which the advantages of the $4\pi\beta$-γ coincidence method in eliminating self-absorption errors are extended to pure β-emitters by the addition of suitable β-γ "tracer" nuclides. Calculations based on several models for the self-absorption process together with further experimental results supporting the method are presented and compared. Use of these theoretical considerations in making corrections for complex disintegration schemes in coincidence counting is discussed. ***P. J. Campion, J. G. V. Taylor, Janet S. Merritt, and J. M. Kennedy.*** *International Journal of Applied Radiation and Isotopes,* v. 8, no. 1, May 1960, p. 8-19.

Study of (He^3,d) and (He^3,t) Reactions in Light Nuclei at 25 Mev. Angular distributions for the $Be^9(He^3,d)B^{10}$, $Be^9(He^3,t)B^9$, $C^{13}(He^3,d)N^{15}$, and $Ca^{40}(He^3,d)Sc^{41}$ reactions were measured at 25 Mev and also at 21 Mev for the C reaction. It was found that the angular distributions were strongly peaked forward, exhibited diffraction-like structure, and were asymmetric about 90°. The minimal positions of the angular distributions could be fitted with spherical Bessel functions of the appropriate order l, the angular momentum transfer of the ingoing proton. This analysis resulted in the same interaction radius for various levels in each of these reactions. The experimental equipment and the method of data analysis, using computer codes, is described. The ground-state Q values were measured for the $Ca^{40}(He^3,d)Sc^{41}$, $Ca^{40}(d,n)Sc^{41}$, and $O^{16}(He^3,d)F^{17}$ reactions. Q values for levels excited by the $Ca^{40}(He^3,d)Sc^{41}$ reaction were also measured. ***H. E. Wegner and W. S. Hall.*** *Physical Review,* v. 119, 2nd ser., no. 5, Sept. 1, 1960, p. 1654-1665.

Experiment on Charge Independence in Interactions of Nucleons and Pions. The ratio (R) of the differential cross sections of the reactions $p+d \rightarrow H^3+\pi^+$ and $p+d \rightarrow He^3+\pi^0$ has been measured at a bombarding energy $Ep = 591$ Mev. The He^3 and H^3 nuclei are detected by the combination of magnetic deflection, time-of-flight measurement and pulse-height selection. The results are $R = 2.26\pm0.11$, 2.10 ± 0.14, and 2.05 ± 0.09 at c.m. angles of the heavy particles of 52°, 67°, and 143°, respectively. The agreement with the predictions of charge independence is satisfactory when the Coulomb and mass corrections are taken into account. ***D. Harting, et al.*** *Physical Review,* v. 119, 2nd ser., no. 5, Sept. 1, 1960, p. 1716-1725.

a **Magnetic Scattering of Neutrons by Exchange-Coupled Lattices.** The magnetic scattering of slow neutrons of arbitrary initial polarization by an extensive class of magnetically coupled lattices is treated by a time-dependent operator approach for the case of complete orbital quenching of the magnetic ions. This magnetic scattering is carefully divided into purely magnetic and magneto-vibrational scattering, the types thereof involving, b respectively, only zero-phonon processes and solely nonzero-phonon processes, and general formulas for these two types of scattering are obtained. These formulas are applied in temperature regions which are sufficiently large (I) or sufficiently small (II) compared with the temperature above which paramagnetism obtains. ***A. W. Sáenz.*** *Physical Review,* v. 119, 2nd ser., no. 5, Sept. 1, 1960, p. 1542-1559.

c **Effect of Crystal Thickness and Geometry on the Alpha-Particle Resolution of CsI(Tl).** The resolution of CsI(Tl) for Po^{210} alpha particles was measured as a function of crystal thickness. The best resolution of a ½-in. diameter cylindrical crystal was obtained for a thickness of 0.38 mm, and the effect of thickness on the resolution is discussed. Based on the proposed model, a conical crystal was designed, which yielded a d line width of 1.8% for Po^{210} alpha particles with a selected photomultiplier tube. ***Prudencio Martinez and Frank E. Senftle.*** *Review of Scientific Instruments,* v. 31, Sept. 1960, p. 974-977.

* **Design of Reinforced Cylinder for Nuclear Reactor Pressure Vessel.** The reinforcement consists of a number of layers e of comparatively thin plate, fitted around the main cylindrical shell, the joints being welded. Experimental work was done with the help of two one-tenth scale models. Concludes that the cylindrical part of the pressure vessel can be reinforced by thin laminar strips to make it suitable for working at the same pressure as for the hemispherical ends. ***R. W. Lakin and S. S. Gill.*** *Engineer,* v. 210, Sept. 23, 1960, p. 495-499.

f **Radiation Pulses and Electronics.** Ionizing radiation can introduce spurious signals, distort normal ones and cause permanent malfunction. Inspecting responses to short pulses sometimes reveals the mechanisms involved. ***John W. Clark and Thomas D. Hanscome.*** *Nucleonics,* v. 18, Sept. 1960, p. 74-77.

g **Branching Ratio of the Electronic Mode of Positive Pion Decay.** A new measurement of the branching ratio $(\pi^+ \rightarrow e^+ \nu)/(\pi^+ \rightarrow \mu^+ + \nu)$ was completed. A double-focusing magnetic spectrometer was used to observe the spectra of electrons emitted in π decay and in μ decay. The scintillation pulses from the pion and its decay electron were recorded on a travelling-wave oscilloscope. Timing and pulse-height measurements were used to distinguish good events from accidentals. The total h number of π-e events recorded in this experiment was 1346, of which 6% were accidentals and 5% were π-μ-e contamination. The branching ratio obtained from an analysis of the data over the π-e and μ-e distributions and corrected to include all decay electrons was $(1.21\pm0.07)\times10^{-4}$. ***H. L. Anderson, T. Fujii, R. H. Miller, and L. Tau.*** *Physical Review,* v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 2050-2067.

i **Elastic Scattering of Fast Neutrons by Tritium and He^3.** Differential cross sections were obtained for the elastic scattering the neutrons by tritium and by He^3 at $E_n = 1.0$, 2.0, 3.5, and 6.0 Mev over the angular range 27° to 161° in the c.m. system. The Los Alamos large Van de Graaff accelerator and pulsed-beam time-of-flight facility were employed, and the scattering samples were contained in small thin-walled stainless j steel spheres. One-third mole of He^3 was contained at 5000 psi and one-half mole of tritium was prepared in the form of CaT_2. Absolute cross sections were determined from a comparison with the scattering from a thin shell of CH_2 at each energy, together with calibration of the relative sensitivity of the detector as a function of energy by the known forward yield of the $T(p,n)He^3$ reaction. The angular distributions for n-T scattering are in excellent agreement with the calculations of k Bransden, Robertson, and Swan based on a Serber exchange force. The n-He^3 measurements favor qualitatively the Serber rather than the symmetrical exchange force used in the cal-

culations, but the agreement is poorer than that obtained for n-T scattering. The polarization of elastically scattered 1-Mev neutrons was found to be less than 5% for both samples, unlike the strong polarization observed in n-He^4 scattering. ***J. D. Seagrave, L. Cranberg, and J. E. Simmons.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 1981-1991.

* **The Instrumentation of the Karlsruhe Research Reactor FR 2, a General Survey.** The reactor FR 2 is a heterogeneous research reactor of the closed-tank type, in which natural, metallic U is used as nuclear fuel, and heavy water as moderator, coolant and reflector. Its thermal power is 12 megawatts, its maximum thermal neutron flux density 3 x 10^{13} neutrons/cm^2sec. The reactor core contains 157 fuel elements, 31 Th fertile elements, 16 combined shim-safety rods, one control rod, and a number of horizontal and vertical holes for experimental work and isotope production. Two circulating systems—the heavy-water system and the He system—are connected to the reactor core. ***Peter Dosch and Ernst Schneider.*** *Siemens Review*, v. 27, no. 8, 1960, p. 244-249.

* **Central Three-Body Forces in Heavy Nuclei.** Three-nucleon potentials are calculated using the renormalized, static theory of Chew and Low. These potentials are used to evaluate the three-body contribution to the total energy per nucleon in nuclear matter as a function of nuclear density. It is found that while the three-body energy is greater than that predicted by unrenormalized theories by about one order of magnitude as a result of multiple-scattering effects, its dependence on the nuclear density in the region of the equilibrium density is very weak. Three-body forces are, therefore, not expected to change the saturation properties of nuclear matter as predicted by a hard core potential to any appreciable extent. ***Robert C. Smith and Robert T. Sharp.*** *Canadian Journal of Physics*, v. 38, Sept. 1960, p. 1154-1167.

* **Isotopic Spin Conservation and Beta-Gamma Circular Polarization Correlation in A^{41} and Sc^{46}.** Experiments were performed which indicate that at least in the cases of the β decay of Sc^{44}, Mn^{52}, and Sc^{46} the isotopic spin conservation law is poorly obeyed, if obeyed at all. These experiments, which so far constitute the only evidence for this breakdown, measure the β-γ circular polarization correlation using the method introduced by Schopper and Boehm and Wapstra. ***Stewart D. Bloom, Lloyd G. Mann, and John A. Miskel.*** *Physical Review Letters*, v. 5, no. 7, Oct. 1, 1960, p. 326-329.

Heavy Isotope Abundances in Mike Thermonuclear Device. The November 1, 1952 thermonuclear explosion ("Mike") produced all of the U isotopes U^{239}, U^{240},...U^{255} through multiple-neutron capture by U^{238}. The long-lived products of successive β-decays from these isotopes were mesasured mass spectrometrically and radiometrically. The logarithms of the abundances decline smoothly with increasing mass number; the even-mass abundances slightly exceed the geometric means of adjacent odd-mass abundances. Some nuclear properties of neutron-rich heavy nuclides, not subject to ordinary investigation, are inferred. ***H. Diamond, et al.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 2000-2004.

Antiproton-Proton Cross Sections at 1.0, 1.25, and 2.0 Bev. The interaction of 1.0-, 1.25-, and 2.0-Bev antiprotons with protons was studied with the aid of a 4π solid-angle scintillation-counter detector system. The measured total cross sections at the above energies are 100, 89, and 80 mb, respectively. At each energy, the charge-exchange cross section is approximately 5 mb. The total elastic cross sections are 33, 28, and 25 mb, respectively, at the three energies. The angular distribution of elastic scattering was fitted with a simple optical-model calculation. ***Rafael Armenteros, Charles A. Coombes, Bruce Cork, Glen R. Lambertson, and W. A. Wenzel.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 2068-2073.

Introductory Nuclear Theory. The fundamental aspects of nuclear physics are treated in detail and those aspects of quantum theory that are required for the subject are fully explained. It should be suitable as a theoretical introduction both for degree candidates and for post-graduate students. ***L. R. B. Elton.*** 286 pp. 1959. Interscience Publishers, New York. (QC776 EL84i)

Neutron Detection. Addressed to those who, with some background knowledge of nuclear physics and particle detectors, require a more detailed knowledge of the main methods of neutron detection. ***W. D. Allen.*** 260 pp. 1960. Philosophical Library, New York. (QC721 AL54n)

High Energy Nuclear Physics. Deals with pion physics, that is, pion scattering by nucleons, the photoproduction of pions, and pion production by nucleons, and with nucleon-nucleon and nucleon-complex nucleus interactions in the energy region above 100 MeV. ***W. O. Lock.*** 190 pp. 1960. John Wiley & Sons, New York. (QC721 L78h)

Light Quanta and Heavy Bosons. The new treatment of space-time reflexions presented in a recent paper has led to wave equations whose solutions describe π- and K-mesons with correct isobaric spin properties. Generalization of this wave equation now leads to (i) an isobaric spin triplet (π-mesons), a singlet with zero mass (Maxwell equations, light quantum), an isobaric spin quadruplet with zero mechanical spin (K-mesons), and a particle with equal isobaric spin properties, but unit mechanical spin. ***H. Frohlich.*** *Royal Society, Proceedings*, v. 257, ser. A, Sept. 20, 1960, p. 283-290.

Elementary Particles and Symmetry Principles. Discusses production of particles and their decay, problems of existence and behavior of elementary particles, symmetry principles and constants of motion, discrete space-time symmetrics, transformation and invariance, Lorentz group, decomposability of matrices to block diagonal form, conditions for indecomposability and irreducibility, and other problems. ***M. A. Melvin.*** *Reviews of Modern Physics*, v. 32, no. 3, July 1960, p. 477-518.

Stripping Reactions and the Structure of Light and Intermediate Nuclei. Discusses empirical reduced widths, theoretical analysis of reduced widths, stripping and pickup reactions on lp-shell and ds-shell nuclei and on heavier nuclei ($A>40$), review of the information obtained from the analysis of empirical reduced widths. ***M. H. Macfarlane and J. B. French.*** *Reviews of Modern Physics*, v. 32, no. 3, July 1960, p. 567-691.

* **Gamma Radiation Fall-Out.** A method for calculating fall-out γ radiation intensities within structures has been developed at the National Bureau of Standards. This method makes possible simple calculations of intensities within basements. Ultimately it should lead to improved theoretical treatment of radiation shielding properties. *Nuclear Energy*, Sept. 1960, p. 419-420.

OPERATIONS RESEARCH

Professional Growth—A Continuing Obligation. I. Stresses the young engineering graduate's duty to broaden his outlook and to accept professional responsibilities. ***Merritt A. Williamson.*** *Research/Development*, v. 11, Oct. 1960, p. 31 + 4 pages.

* **Engineers and Management.** The basic conflict in attitudes between management and the professional employee is not bad; it is in fact necessary to the accomplishment of objectives in a progressing industrial organization. Utilization of the various motivating desires depends upon setting objectives for individuals and groups which provide satisfaction for the employee and at the same time are in harmony with the over-all objective. ***T. A. Harvie.*** *Canadian Aeronautical Journal*, v. 6, no. 8, Oct. 1960, p. 315-319.

* **A Decision Rule for Improved Efficiency in Solving Linear Programming Problems With the Simplex Algorithm.** The concept of smallest angle and the concept of a recognizable constraining subset of the restriction make up the basis for the selection method. In either of the problems cited earlier as examples, several variables changed status (basis to nonbasis or nonbasis to basis) at least twice. It is practical to expect more efficiency from selection methods than that now obtained. The success of this new selection rule suggests a beginning improvement, rather than a limit to solution efficiency with the Simplex algorithm. ***J. C. Dickson and F. P. Frederick.*** *ACM Communications*, v. 3, Sept. 1960, p. 509-512.

* **Manufacturing Systems Simulation.** Simulation—the creation of artificial conditions to test ideas, techniques, or physical actions—is now an in-plant reality. With it, plant men can evaluate operations decisions. They learn results before they happen. ***H. F. Dickie and E. C. Throndsen.*** *Factory*, v. 118, Oct. 1960, p. 114-117.

* **What 320 Companies Say About Job Evaluation.** The survey findings point up resistance, successes, surprises. ***John A. Patton.*** *Factory*, v. 118, Oct. 1960, p. 108-111.

The Economic Distribution of Coal Supplies in the Gas Industry: An Application of the Linear Programming Transport Problem. ***H. G. Berrisford.*** *Operational Research Quarterly*, v. 11, no. 3, Sept. 1960, p. 139-150.

Some Optimization Problems in Advertising Media Planning. An account of the first stage of a multi-stage research program in the planning of advertising media schedules. ***A. M. Lee and A. J. Burkart.*** *Operational Research Quarterly*, v. 11, no. 3, Sept. 1960, p. 113-122.

An Algorithm for the Allocation Problem. Sets out a procedure for solving allocation problems, on different lines from procedures based on linear programming. ***T. E. Easterfield.*** *Operational Research Quarterly*, v. 11, no. 3, Sept. 1960, p. 123-129.

Stock Control With Random Opportunities for Replenishment. Situations sometimes arise, in which replenishment tends to be governed by the incidence of external opportunities which occur at irregular intervals, usually as a result of a complex schedule of production or distribution. Conventional stock-control procedures can then become difficult to operate effectively. Discusses an alternative procedure which can be used in such circumstances, and shows how optimum control levels may be calculated. ***J. K. Friend.*** *Operational Research Quarterly*, v. 11, no. 3, Sept. 1960, p. 130-136.

ORE AND MATERIALS BENEFICIATION

* **Heat Effect Upon Magnetic Separation of Certain Beach Sand Minerals.** Pertains to zircon, ilmenite, rutile, quartz, and others. ***L. T. Morgan.*** *Mining & Chemical Engineering Review*, v. 52, no. 11, Aug. 15, 1960, p. 70-72.

* **Use of Flotation in Treating Radioactive Effluents.** Iron hydroxide with sorbing radioactive isotopes is floated from aqueous solutions. During flotation the radioactive isotopes are not desorbed practically. The flotability was studied in relation to the alkalinity of the solution, of the initial concentration of the reacting substance, and of the foreign admixtures. A hypothesis is stated concerning the chemical character of the reaction of iron hydroxide and the flotation agent studied. (*In Russian.*) K voprosu o primenenii flotatsii pri ochistke radioaktivnykh stochnykh vod. ***S. A. Voznesenskii, et al.*** *Atomnaia Energiia*, v. 9, no. 3, Sept. 1960, p. 208-213.

* **Fluorspar and Its Beneficiation.** Presents in brief the world occurrences of fluorspar with special reference to Indian deposits. ***P. V. Raman and P. I. A. Narayanan.*** *Blast Furnace and Steel Plant*, v. 48, Oct. 1960, p. 1045-1050.

Study of Zirconium Fixation by Acid Montmorillonite. Comparing results with those obtained elsewhere for salts of other elements (alkalis, alkaline earths, uranium), anomalies with regard to the fixation capacity (2.4 meq ZrO^{++}/g of clay while the exchange capacity for the other ions is close to 1 meq/g) were observed. The most probable explanation is that Zr is fixed on clay in the form of very condensed ions. (*In French.*) Etude de la fixation du zirconium par la montmorillonite acide. ***R. Bittel, C. Boursat, and R. Platzer.*** *France, Commissariat a l'Énergie Atomique, Rapport CEA No.* 1581, 1960, 19 pp. (QC770 F84.2r Contin.)

* **On the Correlative Bonds of the Rare-Earth Elements and Some Peculiarities of Rare-Earth Separation in the Processes of Endogenous Mineral Formation.** The study of variations in the composition of rare-earths in a number of minerals of a different genesis (monazite, rinkolite, sphene, apatite, perowskite) with the aid of a correlative "lanthanum" graph shows that in many geochemical processes a division of the rare-earths into two groups—"more basic" and "less basic" elements, is observed. (*In Russian.*) O korreliatsionnykh sviaziakh redkozemel'nykh elementov i nekotorykh osobennostiakh razdeleniia redkikh zemel' v protsessakh endogennogo mineraloobrazovaniia. ***L. S. Borodin.*** *Geokhimiia*, 1960, no. 6, p. 506-517.

* **Extraction of Metals From Sulphide Ores by Wet Methods.** Chemistry of oxidation of sulphides; control by transport in solution of reactants or products of oxidation; control of chemical reaction on the surfaces of the minerals or in solution; oxidation states of S in the end-products of leaching. ***F. A. Forward and I. H. Warren.*** *Metallurgical Reviews*, v. 5, no. 18, 1960, p. 137-164.

* **Fine Coal Cleaning With Tables.** Résumé of the Pocahontas Fuel Company's field experience with tables in cleaning raw coal. ***A. E. Copeland, G. N. Haynes, and C. W. Porterfield.*** *Mining Congress Journal*, v. 46, Oct. 1960, p. 44-47.

* **Arguments for the Pertinency of Zinc and Lead Ores Preliminary Dressing.** It has been proved that the losses arising during sedimentation enrichment are due to improper working of the sifters. The formulae for a limit of Zn content in the sedimentation wastes have been deduced as well as a limiting exit of such wastes. An example of working conditions and definite raw material confirms the pertinency of the preliminary dressing, taking economical considerations. (*In Polish.*) Uzasadnienie celowości wzbogacania wstępnego rud cynkowo-ołowiowych. ***Kazimierz Dąbrowski.*** *Rudy i Metale Niezelazne*, v. 5, no. 8, Aug. 1960, p. 326-330.

* **Copper Flotation With Silver Nitrate, Based on the Silver Precipitation and Flotation Tests at the Kongsberg Silver Plant.** It might be possible to increase the extraction of Cu minerals by adding a water-soluble silver salt to the pulp. Flotation experiments on a complex sulfide-ore, consisting of pyrite, phyrrotine, chalcopyrite, and sphalerite, and with 3.5% Cu were carried out in a laboratory scale. By adding 20 gr/ton $AgNO_3$ to the pulp, the grade of extraction increased by 4%. (*In Norwegian.*) Kobberflotasjon med sølvnitrat, på grunnlag av erfaringer fra felling og flotasjon av sølv ved Kongsberg Sølverk. ***Anders M. Heltzen.*** *Tidsskrift for Kjemi, Bergvesen og Metallurgi*, v. 20, no. 7, Sept. 1960, p. 183-184.

Rapid Evaluation of Spodumene and Kyanite Samples by Heavy Liquid Separation. ***James S. Browning and John B. Gayle.*** *U. S. Bureau of Mines Report of Investigations* 5657, 1960, 5 pp. (TN21 Un3r Room 290)

PHYSICS

Equilibrium Properties of a Partially Ionized Plasma. A model for a partially ionized, partially dissociated plasma was formulated, using known theoretical concepts to describe both bound and free electron states, internal molecular degrees of freedom, and Coulomb interactions. It has been applied to a system of particles arising from the H molecule. The Coulomb interaction is treated in the classical Debye approximation. ***Gilda Maki Harris, John E. Roberts, and John G. Trulio.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 1832-1841.

Diffraction of an Electromagnetic Plane Wave by a Metallic Sheet. A new generalized technique is developed for the solution of the problem of the diffraction of a plane-wave incident at an oblique angle on an imperfectly conducting half plane. It is shown that the solution may be deduced directly from the known scalar solutions for the half plane. The case when the incident wave is *E*-polarized is considered in detail. The method of solution is applicable to the case of an *H*-polarized wave. ***W. E. Williams.*** *Royal Society, Proceedings*, v. 257, ser. A, Sept. 20, 1960, p. 413-419.

Change in Structure of Blue and Green Fluorescence in Cadmium Sulfide at Low Temperatures. The two fundamental fluorescences observed in cadmium sulfide crystals sub-

jected to ultraviolet excitation at low temperatures are classified according to wavelength. Photographs of the two fluorescences at 4.2 K and 77 K are given, and their structures are compared. Experimental evidence on the change in structure of the green emission near 5130A between 4.2 K and 77 K is presented and used to confirm an explanation for the apparent "green" shift in cadmium sulfide proposed by D. G. Thomas and J. J. Hopfield. ***L. S. Pedrotti and D. C. Reynolds.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 1897-1898.

Dielectric Constant of a Dense Electron Gas. The problem of absorption and dispersion of electromagnetic waves in a dense electron gas is treated semiclassically through the use of Boltzmann equation and Fermi-Dirac statistics. The singularity in the dispersion formula is treated by the method of Van Kampen. Expressions for the dielectric constant and conductivity as functions of frequency were obtained for temperatures at and near absolute zero. ***T. Pradhan and P. Misra.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 1878-1881.

Damping of a Torsionally Oscillating Cylinder in Liquid Helium at Various Temperatures and Densities. A method is described for measuring the product of the viscosity and the density of liquid He by determining the energy dissipation of a piezoelectric cylinder of quartz oscillating in a torsional mode. Data are reported for liquid He under its own vapor pressure as well as at higher densities. ***Benjamin Welber.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 1816-1822.

Spin Relaxation of *F*-Center Electrons. Several possible mechanisms leading to spin transitions in the electron-nuclear spin system of an *F*-center electron and its neighboring nuclei were examined. Calculations show that the most probable transition is one in which the electron spin changes, but the nuclear spin does not change, and which results from the second-order perturbation of the spin-orbit coupling of the electron due to lattice vibrations. The spin-lattice relaxation time of the *F*-center electrons in NaCl at 300 K was measured at 70, 2950, and 8300 gauss. The relaxation time is 2×10^{-6} second, independent of the magnetic field, in approximate agreement with the theory. ***W. E. Blumberg.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 1842-1850.

Measurement of *F*-Center Concentration and Relaxation Time by Microwave Faraday Rotation. The use of a bimodal cavity for the observation of electron spin resonance is described. The two samples of NaCl containing *F* centers used by Blumberg are investigated by electron spin resonance. Their *F*-center concentrations are found to be 4.4×10^{17} and 2.3×10^{18} electron/cm^3, respectively. The spin-lattice relaxation time at room temperature of the *F*-center electrons is found to be 1.7 microseconds. ***D. T. Teaney, W. E. Blumberg, and A. M. Portis.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 1851-1853.

Dependence of the Optical Bleaching Rate of X-Irradiated KCl Crystals on Light Intensity. ***W. E. Bron and W. R. Heller.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 1864-1868.

Collisions of Electrons With Hydrogen Atoms. V. Excitation of Metastable 2S Hydrogen Atoms. Ground-state H atoms produced by thermal dissociation in a W furnace were excited by collision with electrons having energies up to 600 ev. Those atoms which were excited to the metastable 2S state were subsequently quenched in an electrostatic field, and the resulting Lyman-alpha radiation was detected with an iodine-vapor-filled photon counter. In order to assign absolute cross-section values to the excitation function obtained in this way, the ratio of the 2S to the 2P excitation cross sections was determined. From previously obtained knowledge of the cross section for excitation to the 2P state, the absolute 2S cross section was evaluated. Agreement with the Born approximation was observed at high energies. The angular distribution of the scattered 2S atoms was also investigated for electron energies up to 600 ev. ***R. F. Stebbings, Wade L. Fite, David G. Hummer, and R. T. Brackmann.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 1939-1945.

Lectures in Theoretical Physics. Invariance properties in elementary particle physics, symmetry laws and elementary particle interactions, hypernuclei and the Λ-nucleon interaction, the classical electron, many body problems in quantum mechanics, present status and problems in the theory of β decay, aspects of abstract field theory, and quantum mechanical amplifiers are discussed. ***Wesley E. Brittin and B. W. Downs, editors.*** v. II. 483 pp. 1960. Interscience Publishers, Inc., New York. (QC3 C71L)

High Temperature Thermometry Seminar. Seminar, Oct. 1-2, 1959, at Oak Ridge National Laboratory. ***W. R. Grimes and D. R. Cuneo, editors.*** *U. S. Atomic Energy Commission, TID-7586*, (Pt. 1), Aug. 1960, 171 pp. (UF767 Un3ti Contin.)

* **Evidence for the Containment of a Hot, Dense Plasma in a Theta Pinch.** Describes the results of some measurements which were made of the axial containment of a plasma in a high-power linear Theta pinch device. ***T. S. Green.*** *Physical Review Letters*, v. 5, no. 7, Oct. 1, 1960, p. 297-303.

* **Semiconductors and Infra-Red Spectroscopy.** The use of semiconductors to provide extremely sensitive and fast infrared detectors is discussed; in particular, recent work on InSb detectors for the spectral region 3μ-5.5μ is described and also the extension of photoelectric detection of 135μ using Ge doped with antimony. The use of such detectors led to an extension of infrared techniques which in turn led to some notable advances in our knowledge of the fundamental properties of semiconductors. A number of the more recent advances based on infrared absorption and emission spectroscopy using single crystals are discussed. ***R. A. Smith.*** *Optica Acta*, v. 7, no. 2, Apr. 1960, p. 137-157.

Lattice Anharmonicity and Optical Absorption in Polar Crystals. I. The Linear Chain. A calculation of the optical absorption spectrum of an anharmonic one-dimensional lattice of alternating positively and negatively charged particles of different masses is carried out, using two different approaches: the recent theory of Born and Huang, and ordinary second-order time-dependent perturbation theory. Closed-form expressions for the absorption spectrum are obtained for both low and high temperatures. It is found that subsidiary absorption peaks may be expected at frequencies other than the dispersion frequency ω_d. At high temperatures, the absorption at ω_d varies as T^{-2} or T^{-3}, depending on how certain thermal averages are carried out. Predictions based on these results are made regarding which features of the present spectra can be expected to persist for three-dimensional lattices. ***A. A. Maradudin and R. F. Wallis.*** *Physical Review*, v. 120, 2nd ser., no. 2, Oct. 15, 1960, p. 442-462.

Variational Treatment of Warm Electrons in Nonpolar Crystals. Deviations from Ohm's law in nonpolar crystals are treated for weak fields by the variational method. A simple band structure is assumed. Scattering by both acoustical and optical phonons, and ionized impurities is included. It is shown that the influence of optical phonons on the field dependent mobility (E^2 term where E is the electrostatic field) is maximum for a temperature which corresponds approximately to the optical phonon energy. The field dependent mobility is highly sensitive to ionized impurity scattering as in the case of acoustical phonons alone. Finally, the convergence of the variational method is established in limiting cases using as a representation a set of polynomials which are orthonormal with respect to the collision operator. Extensive calculations are given for electrons in Ge and comparison with experiment is discussed. ***I. Adawi.*** *Physical Review*, v. 120, 2nd ser., no. 1, Oct. 1, 1960, p. 118-127.

Equation of State and Phase Transition of the Spherical Lattice Gas. The spherical lattice gas is a modification of the ordinary lattice gas in which the occupation number of each cell is permitted to be any real number rather than ± 1. However, the sum of squares of the occupation numbers is required to equal the number of cells. This permits one to evaluate the partition function by integrating over the surface of a certain sphere rather than by summing over lattice points on that surface. The partition function and the equation of state of the gas are evaluated in this way. It is found that in three dimensions the gas condenses, but not in one or two dimensions. The analytical work is simplified by taking advantage of the relationship between the properties of the lattice gas and of the Ising model of a ferromagnet. This relationship, demonstrated by C. N. Yang and T. D. Lee for the ordinary lattice gas and Ising model, also applies to the spherical lattice gas and the spherical model of a ferromagnet. ***Walter Pressman and Joseph B. Keller.*** *Physical Review*, v. 120, 2nd ser., no. 1, Oct. 1, 1960, p. 22-32.

Stochastic Equations for Nonequilibrium Processes. A system of weakly interacting particles is described by a time-dependent joint probability distribution in the occupation numbers of the individual particle states. The "master" equation for the distribution is obtained by considering the time evolution of the system as a Markoff process with transition probabilities per unit time given by first-order quantum mechanical perturbation theory. This is done for particles obeying classical and quantum statistics. The resulting equations include the usual rate equations for the average occupation numbers as special cases; but they also yield all higher moments and correlations in the occupation numbers. The general solution and its properties are discussed for the case in which a relaxing subsystem interacts via binary collisions with a larger system having a fixed but not necessarily thermal distribution. ***P. M. Mathews, I. I. Shapiro, and D. L. Falkoff.*** *Physical Review*, v. 120, 2nd ser., no. 1, Oct. 1, 1960, p. 1-16.

* **Entropy—A Thermodynamic Concept and Its Application.** A simple restatement of this concept is followed by examples of its use in evaluating refrigeration cycles. Discusses the first two laws of thermodynamics, calculation of entropy, application of the concept of entropy and irreversibility, and throttling. ***W. Strauss.*** *British Chemical Engineering*, v. 5, Oct. 1960, p. 699-702.

Double Resonance Technique for the Elimination of Proton Spin-Spin Splitting in High Resolution PMR Spectra. The double resonance technique aims at removing the effect of spin-spin coupling by the application of a strong rf field at the resonance frequency of the disturbing nucleus in addition to the weak rf field used for observation of the NMR spectrum. A method is described whereby the weak rf field is obtained by a small audio frequency modulation of the magnetic field strength. This method is applicable to chemically nonequivalent groups of H nuclei to simplify the interpretation of high resolution proton magnetic resonance spectra. Two examples are given. ***Reinhold Kaiser.*** *Review of Scientific Instruments*, v. 31, Sept. 1960, p. 963-965.

Excitation Processes in Helium. An experimental study of the radiation emitted by He under controlled electron impact is described. The observations are analyzed, together with those of previous workers, to yield values for the excitation functions of *S*, *P* and *D* states. The mechanism of excitation transfer between excited states is analyzed in terms of radiative and collisional processes, cascade processes being found to be more important than has hitherto been assumed. The total inelastic (less ionization) cross-section at 108 eV is found to be 2.9 x 10^{-17} cm^2. ***A. H. Gabriel and D. W. O. Heddle.*** *Royal Society, Proceedings*, v. 258, ser. A, Oct. 4, 1960, p. 124-145.

* **Kinetics of the Photoconductivity of Amorphous Selenium Layers Treated With Mercury Vapors.** The kinetics of the photoconductivity for the short-wave (360-580 mmk) and long-wave (600-1000 mmk) region of the spectrum are different, due possibly to the presence of a zone of absorption of amorphous Se in the blue-yellow region. With equal light intensities $\left(\frac{d\sigma}{dt}\right)_{t\to 0}$ the kinetics decreases with the increase of the wavelength. The maximum positive photoconductivity $\Delta\sigma_{max}$ with the increase of the light intensity tends toward a constant value. (*In Russian.*) Kinetika fotoprovodimosti sloev amorfnogo selena, obrabotannogo parami rtuti. ***M. I. Korsunskiĭ, N. S. Pastushuk, and G. D. Mokhov.*** *Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Fizika*, 1960, no. 4, p. 167-172.

* **Temperature Dependency of the Magnetostatic Properties of Nickel-Zinc Ferrites.** An experimental study of the temperature relationship of the initial susceptibility, of the curves of magnetization, of the coercive force and of the magnetization, of saturation of Ni-Zn ferrites F-100 and F-600. The region of the magnetic field of the reversible processes of magnetization was determined. The upper limit of this region can be expressed approximately as $2/3\ H_c$. (*In Russian.*) Temperaturnaia zavisimost' magnitostaticheskikh svoĭstv nikel'-tsinkovykh ferritov. ***D. D. Mishin and L. D. Drobchenko.*** *Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Fizika*, 1960, no. 4, p. 131-134.

Effects of Collisions on the Cyclotron Radiation From Relativistic Particles. The effects of collisions on the cyclotron radiation from relativistic particles are investigated, supposing a uniform velocity for the particles. The field equations are derived from the familiar Liénard-Wiechert potentials and Fourier-analyzed. Under the basic assumption that the particles make many revolutions between two collisions, it is shown that the radiation pattern is that of a series of spectral lines, each having a dispersion profile. ***Ludwig Oster.*** *Physical Review*, v. 119, 2nd ser., no. 5, Sept. 1, 1960, p. 1444-1456.

* **The Flight Time by Electrons Through the Grid-Anode Triode Space.** On the basis of the equation of the movement of the electron in a constant and in a variable electric field, a solution was found for the flight angle in the form of a harmonic series. Curves of the dependency of the flight angle on the in-flight phase were given. The effects of the amplitude of the variable voltage on the value of the flight angle were examined. (*In Russian.*) O vremeni prolëta elektronami prostranstva setka-anod trioda. ***G. A. Zeitlënok.*** *Radiotekhnika*, v. 15, no. 9, Sept. 1960, p. 33-39.

* **A Contribution to the Attenuation Effects in Ionic Crystals.** A study of infrared dispersion in some crystals. By means of quantum mechanics methods and of a statistical density matrix, the attenuation connected with the anharmonicity of the vibrations of the crystal lattice was calculated. At high temperatures, the edges of the absorption bands increase in proportion to the temperature and the center decreases in inverse proportion. (*In Russian.*) K teorii effekta zatukhaniia v ionnykh kristallakh. ***V. V. Mitskevich.*** *Izvestiia Vysshikh Uchebnykh Zavedeniĭ, Fizika*, 1960, no. 4, p. 6-12.

Classical Theory of Spin Configurations in the Cubic Spinel. It is shown that the Yafet-Kittel triangular spin-configurations in the cubic spinel do not minimize the classical Heisenberg exchange energy. A theory of the classical ground state more general than that of Yafet and Kittel is investigated. It is concluded that equilibrium configurations exist which have nonzero angles between spins on the *A* sites simultaneously with angles between those on the *B* sites, in contrast with the Yafet-Kittel results, and that there will be long-range-ordered, canted spin configurations in the cubic spinel, contrary to Anderson's suggestion. These conclusions are discussed in connection with experiments on $MnCr_2O_4$ and Mn_3O_4. ***T. A. Kaplan.*** *Physical Review*, v. 119, 2nd ser., no. 5, Sept. 1, 1960, p. 1460-1470.

Cascade Capture of Electrons in Solids. Enormous capture cross sections in the range 10^{-15} cm^2 to 10^{-13} cm^2 have been observed for a wide variety of Coulomb attractive centers in Si and Ge, some involving binding energies many times the Debye energy. The initial capturing event is likely to involve an optical phonon or an intervalley collision in the room-temperature range, but the acoustic phonon contribution will predominate at low temperatures. Subsequent collisions may eject the electron or cause it to increase its binding energy. The "sticking probability", or probability of eventual capture into the ground state, becomes significant for binding energies of order *kT*. ***Melvin Lax.*** *Physical Review*, v. 119, 2nd ser., no. 5, Sept. 1, 1960, p. 1502-1523.

Vapor Pressure Data for Some Common Gases. For 26 gaseous compounds that are frequently encountered in ultra-high-vacuum or low-temperature work, the following data have been selected, evaluated, tabulated, and plotted: vapor pressures; transition, melting, and boiling points; and their associated energies. Vapor pressures have been plotted as log p (mm Hg or Torr) versus log T (° K). ***R. E. Honig and H. O. Hook.*** *RCA Review*, v. 21, no. 3, Sept. 1960, p. 360-368.

The Antiferromagnetic Susceptibility at Moderate Fields. The isothermal differential susceptibility of an antiferromagnetic substance in a moderately strong magnetic field of arbitrary direction is calculated from the molecular field model as given by Gorter and Mrs. Van Peski-Tinbergen. The results are compared with the formulae of Nagamiya and Yosida and with experimental results on hydrated Cu and manganese chlorides. ***J. Van Den Broek and C. J. Gorter.*** *Physica*, v. 26, Aug. 1960, p. 638-646.

* **Some Remarks on Collective Description of Electron Interactions. The Partition Function.** The nearly-Hermitian variant of collective description is formulated. The correct partition function is obtained. Thereby the exact proof is given that the subsidiary conditions proposed by Kanazawa lead to false results, whereas those of Bohm and Pines yield the exact

statistical function, provided the renormalizing procedure proposed by the author in a former paper is applied to their theory. ***Jan Sledzik.*** *Acta Physica Polonica*, v. 19, no. 3, 1960, p. 383-403.

* **X-Ray Microscopy and Microanalysis.** By microphotometry of negatives taken at selected wavelengths, absorption microspectrometry can be made a quantitative tool. It is more versatile than the emission method. The different experimental arrangements for microscopy and microanalysis are: contact microradiography, projection X-ray microscopy, reflection X-ray microscopy, scanning microscopy. The apparatus and procedures are described. ***V. E. Cosslett.*** *Metallurgical Reviews*, v. 5, no. 18, 1960, p. 225-266 + 16 plates.

Space-Time Reflexions, Isobaric Spin and the Mass Ratio of Bosons. Gives a new treatment in terms of continuous transformations involving a new angular space (denoted as isospace). This space permits definition of dynamical variables which can be interpreted in terms of isobaric spin, electric charge and mass. Application to bosons results in a mass ratio and isobaric spin assignment in perfect agreement with the empirical values. ***H. Fröhlich.*** *Royal Society, Proceedings*, v. 257, ser. A, Sept. 6, 1960, p. 147-164.

Behavior of the Principal Elastic Moduli and Specific Heat at Constant Volume of KCl at Elevated Temperatures. Measurements of the adiabatic elastic constants of potassium chloride (KCL) were made in the region 300 K to the melting point (1043 K) by a dynamical method developed by Balamuth. Recently determined values of the specific heat at constant pressure (C_p) were used to calculate the isothermal values of the compressibility. Values of the specific heat at constant volume (C_v) were obtained, using recent values of the coefficient of thermal linear expansion (α), the above mentioned values of C_p, and the isothermal compressibilities. The results indicate that there is a slight rise in C_v above the Dulong-Petit value above 725 K. This rise is not significant, since the estimated error interval encloses the Dulong-Petit value, and consequently the D-P law is most likely valid up to the melting point. ***Frank D. Enck.*** *Physical Review*, v. 119, 2nd ser., no. 6, Sept. 15, 1960, p. 1873-1877.

Experiments on the Growth Rate of Surface Instabilities in a Linear Pinched Discharge. Photographic observations on the growth of surface instabilities in a linear pinched discharge are presented, and numerical results on the growth rates are deduced from them. These are discussed with reference to the various theoretical studies made. Shows that the Rayleigh-Taylor type of instability is likely to be the dominant process. ***F. L. Curzon, A. Folkierski, R. Latham, and J. A. Nation.*** *Royal Society, Proceedings*, v. 257, ser. A, Sept. 20, 1960, p. 386-401 + 3 plates.

PLASTICS

* **Polymers From Vinyl Fluoride.** Free-radical polymerization of vinyl fluoride was studied with the use of organic peroxide and azo initiators over the temperature range of 60-150 C and at pressures of 75-1000 atm. Molecular weights of the polymers vary over the range of 45,000 to 180,000 depending on polymerization conditions employed. ***G. H. Kalb, D. D. Coffman, T. A. Ford, and F. L. Johnston.*** *Journal of Applied Polymer Science*, v. 4, no. 10, July-Aug. 1960, p. 55-61.

* **Radical Termination Mechanisms in Bulk Polymerization.** Termination mechanism in the bulk polymerization of styrene and vinyl acetate initiated by α,α'-azobisisobutyronitrile. C^{14}-labelled initiators were employed and activities of samples were determined by internal liquid scintillation counting. ***B. L. Funt and W. Pasika.*** *Canadian Journal of Chemistry*, v. 38, Oct. 1960, p. 1865-1870.

* **On the Block-Condensation of the Polyethylene Terephthalate With Polyesters.** Discusses the interchange reactions taking place in the melt between polyethylene terephthalate and various polyesters, and the factors determining their rate of reaction. By shortened condensation, the preparation succeeds of block-polyesters, which may be spun into fibers with improved dyeing properties. Polyethylene hexahydroterephthalate is especially appropriate for the block component. (*In German.*) Über die Blockkondensation des Polyäthylenterephthalats mit Polyestern. ***Peter Kresse.*** *Faserforschung und Textiltechnik*, v. 11, Aug. 1960, p. 353-359.

How to Extrude Plastisols. Pump feeding of plastisols overcomes surging and low rates with fast gel formulations. ***C. H. Brower and B. H. Maddock.*** *Modern Plastics*, v. 38, no. 2, Oct. 1960, p. 127 + 3 pages.

The ABMA Reinforced Plastics Ablation Program. The place of reinforced plastics for applications in hyperthermal environments is discussed. Surface conditions during re-entry, mechanical and electrical properties of the material, and manufacturing feasibility are important considerations. ***W. R. Lucas and J. E. Kingsbury.*** *Modern Plastics*, v. 38, no. 2, Oct. 1960, p. 135 + 5 pages.

* **Methyl Acrylate as a Monomer in Glass Fiber Reinforced Polyester Laminates.** Methyl methacrylate modified resins show weather resistance and light stability superior to standard polyester resins, when prepared using only styrene as a cross linking monomer. ***Murray C. Slone.*** *SPE Journal*, v. 16, Oct. 1960, p. 1123-1127.

* **Advances in Vinyl Plastics Test Methods.** Test methods for PVC show a decided trend with an emphasis on permanence characteristics. Activity is centered on tests for resistance to the effect of heat, light, microorganisms, and the interaction of vinyls with other materials such as hydrogen sulfide, rubber compounds, organic finishes, and metals. ***J. B. DeCoste.*** *SPE Journal*, v. 16, Oct. 1960, p. 1129-1133.

* **Molding Flexible Polyether Urethane Foams.** Process for molding thin sections of one-shot polyether foams in thin-gage metal molds. Unique feature of the process is a high-output source of radiant heat. ***P. G. Gemeinhardt, J. F. Szabot, A. S. Morecroft, and J. H. Saunders.*** *SPE Journal*, v. 16, Oct. 1960, p. 1117-1119.

* **Investigation of Diffusion Processes in Some Polymers. III. Irreversible Change in Diffusion Characteristics by Action of Co^{60} Gamma Irradiation of the Polymer.** The diffusion of He and Ar through polymers subjected to various integral doses of γ radiation has been investigated. The diffusion rate of He and Ar in SKS-30, polyethylene and polyamides diminishes with increasing integral dose, which is evidently due to formation of cross links. (*In Russian.*) Issledovanie diffuzionnykh protsessov v nekotorykh polimerakh. III. Neobratimye izmeneniia diffuzionnykh kharakteristik v rezul'tate deĭstviia na polimer gamma-izlucheniia Co^{60}. ***N. S. Tikhomirova, Iu. M. Malinskiĭ, and V. L. Karpov.*** *Vysokomolekuliarnye Soedineniia*, v. 2, no. 9, Sept. 1960, p. 1335-1348.

* **Synthesis of Polymers Containing Siloxane and Hydrocarbon Units in the Macromolecular Backbone and Investigation of Their Structure. IV.** The reaction of acetylene and of its derivatives with dihydrodisiloxanes was investigated. Polymer products were obtained and their structure was determined. Polymers with vinyl and groups were capable of further polymerization in the presence of a peroxide initiator to form solid insoluble products. (*In Russian.*) Poluchenie i issledovanie struktury polimerov, soderzhashchikh siloksanovye i uglevodorodnye zven'ia v osnovnykh tsepiakh makromolekul. IV. ***A. M. Poliakova, V. V. Korshak, M. D. Suchkova, V. M. Vdovin, and N. A. Chumaevskiĭ.*** *Vysokomolekuliarnye Soedineniia*, v. 2, no. 9, Sept. 1960, p. 1360-1369.

The Chemistry of Xylylenes. VI. The Polymerization of *p*-Xylylene. VII. Some Reactions of *p*-Xylylene That Occur *via* Cationic Intermediates. VI. ***L. A. Errede, R. S. Gregorian, and John M. Hoyt.*** VII. ***L. A. Errede, John M. Hoyt, and R. S. Gregorian.*** *American Chemical Society, Journal*, v. 82, Oct. 5, 1960, p. 5218-5227.

* **Calorimetric Studies of States and Transitions in Solid High Polymers.** A review limited to calorimetric studies on solid high polymers in the temperature range −20 to 300 C. ***Malcolm Dole.*** *Fortschritte der Hochpolymeren-Forschung*, v. 2, no. 2, 1960, p. 221-274.

* **Block and Graft Copolymers.** Chain transfer initiation, initiation by activation, chemical methods, ionic mechanisms, and condensation of preformed polymers. ***G. Smets and R. Hart.*** *Fortschritte der Hochpolymeren-Forschung*, v. 2, no. 2, 1960, p. 173-220.

Wetting Properties of Tetrafluoroethylene and Hexafluoropropylene Copolymers. Effect on wetting of the progressive replacement of $-CF_2-$ by $-CF_3$ groups in the surface of the bulk polymer. ***Marianne K. Bernett and W. A. Zisman.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1292-1294.

Some Aspects of the Rotating Sector Determination of the Absolute Rate Constants in Radical Polymerization Reactions. Some of the possible sources of error in the rotating sector determination are examined. A method of computing the absolute rate constants in radical photopolymerization reaction was devised which takes account of dark reaction rates in both the dark and light periods of the measurement. A basis is presented for estimating the magnitudes of dark reaction rates which can be neglected in such calculations. Consideration also is given to the effect of a non-uniform distribution of radical centers due to such factors as nonuniform absorption of the incident beam. ***Harold Kwart.*** *Journal of Physical Chemistry*, v. 64, Sept. 1960, p. 1250-1254.

In the Rocket Nozzle Environment. Pick the Right Plastic. Information is given on how to analyze the design, specify the parts, and get the quality. ***Wesley C. Mace.*** *Aircraft and Missiles*, v. 3, Oct. 1960, p. 44-45.

Ionic Polymerization. XVI. Reactions of 1-Cyclopropylethanol-Vinylcyclopropane. The pyrolysis of 1-cyclopropylethyl acetate yielded cyclopentene and smaller amounts of vinylcyclopropane and 1,4-pentadiene while the sulfuric acid-catalyzed dehydration of 1-cyclopropylethanol produced vinylcyclopropane, 2-methyl-tetrahydrofuran and small amounts of both cyclopentene and 1,4-pentadiene. The pyrolysis of 1-cyclopropylethyl S-methyl xanthate yielded vinylcyclopropane and a trace amount of 1,4-pentadiene while a simultaneous rearrangement of 1-cyclopropylethyl S-methyl xanthate produced 1-cyclopropylethyl methyl dithiolcarbonate. Mechanisms for these thermal and acid-catalyzed rearrangements are discussed. ***C. G. Overberger and A. E. Borchert.*** *American Chemical Society, Journal*, v. 82, Sept. 20, 1960, p. 4896-4899.

* **Determination of Microtacticity in Polypropylene Chains by the Method of Polarized Infrared Spectra.** The ratio of the dichroism of the 2926 cm^{-1} to the 2845 cm^{-1} band was shown to depend upon the microtacticity of the polymer and to be independent of the degree of crystallinity and elongation of the specimens. (*In Russian.*) Opredelenie "mikrotaktichnosti" v tsepiakh polipropilena metodom poliarizovannykh infrakrasnykh spektrov. ***B. Z. Volchek and Zh. N. Roberman.*** *Vysokomolekuliarnye Soedineniia*, v. 2, no. 8, Aug. 1960, p. 1157-1161.

* **Formation of Stable Free Radicals in the Hardening and Thermal Degradation of Phenol-Formaldehyde Resins.** It was found that the free radicals form during thermal treatment of the resin in the temperature region where partial degradation of the three-dimensional molecular networks is found to take place. (*In Russian.*) Obrazovanie seabil'nykh svobodnykh radikalov v protsesse otverzhdeniia i termicheskoĭ destruktsii fenol'no-formal'degidnykh smol. ***L. A. Igonin, Yu. A. Eliseev, O. A. Dyurgerov, and N. A. Krasulina.*** *Vysokomolekuliarnye Soedineniia*, v. 2, no. 8, Aug. 1960, p. 1167-1170.

* **Structure of the Molecular Chain of Polyethylene Produced With the Aid of γ-Rays.** Polyethylene produced in the gaseous phase by γ-ray intiated polymerization at 25 C with doses not exceeding $4x10^6$ roentgens and intensities up to 82 roentgens per sec is characterized by a low degree of molecular chain branching. For equal radiation intensities, ethylene concentrations and polymerization temperatures, the mean molecular weight of polyethylene increases with radiation dose. For equal doses, the molecular weight increases with falling intensity. When at the same doses, intensities, and ethylene concentrations, the temperature is raised to 50 C, an increase in the molecular weight of polyethylene and in the degree of branching of its molecular chain is observed. (*In Russian.*) Struktura molekuliarnoĭ tsepi polietilena, poluchennogo pod deĭstviem γ-izlucheniia. ***I. G. Soboleva, N. V. Makletsova, and S. S. Medvedev.*** *Vysokomolekuliarnye Soedineniia*, v. 2, no. 8, Aug. 1960, p. 1234-1238.

* **The Transition Polymerization of Acrylamide. II. On the Reaction Mechanism.** The reaction mechanism of the transition polymerization of acrylamide to poly-β-alanine was studied. The initial reaction occurs by the addition of the base to acrylamide. The infrared analysis of the polymer supports to mechanism. The propagation of the chain occurs by an addition of acrylamide at the anionic amide part of the chain. ***Naoya Ogata.*** *Makromolekulare Chemie*, v. 40, nos. 1-2, Aug. 1960, p. 55-63.

POLLUTION AND WASTES

* **Total Air Pollution Emissions in Los Angeles County.** Air-contaminant classifications, survey techniques, and utilization of total air-pollution data are described. Also discusses emissions from: vehicle exhausts, combustion of liquid and gaseous fuels, evaporation of organic liquids, petroleum refining and chemical processing, incineration of combustible refuse, metallurgical processing, and mineral processing operations. ***Robert L. Chass, Philip S. Tow, Robert G. Lunche, and Norman R. Shaffer.*** *Air Pollution Control Association, Journal*, v. 10, no. 5, Oct. 1960, p. 351-366.

* **A Preliminary Survey of Hydrocarbon-Derived Oxygenated Material in Automobile Exhaust Gases.** Engine operation and chemical composition of the fuel influence the emissions of exhaust gases. Low concentrations of oxygenates are present in exhausts produced during automotive engine cruise and acceleration operations when ignition is consistently good. However, ignition malfunctions will significantly raise emissions of oxygenates. ***K. J. Hughes and R. W. Hurn.*** *Air Pollution Control Association, Journal*, v. 10, no. 5, Oct. 1960, p. 367-373.

* **Eye Irritants Formed During Photo-Oxidation of Hydrocarbons in the Presence of Oxides of Nitrogen.** Individual hydrocarbons were irradiated with near-ultraviolet light in the presence of nitrogen dioxide. Examination of the reacting systems with an infrared spectrophotometer and a gas chromatograph led to ready identification of major products. Two products of the photo-oxidations, formaldehyde and acrolein, were found to be eye irritants. ***E. A. Schuck and N. A. Renzetti.*** *Air Pollution Control Association, Journal*, v. 10, no. 5, Oct. 1960, p. 389-392.

* **The Development of Motor Vehicle Exhaust Emission Standards in California.** ***John A. Maga and Gerhardt C. Hass.*** *Air Pollution Control Association, Journal*, v. 10, no. 5, Oct. 1960, p. 393 + 4 pages.

* **Contamination Resulting From the Release of Radioactive Liquid Wastes to the Tennessee River System.** Indicates that activity levels in the water and bottom sediments of the Clinch and Tennessee Rivers resulting from waste release are well below the hazardous limit to the general population. ***H. H. Abee and W. D. Cottrell.*** *American Industrial Hygiene Association Journal*, v. 21, no. 2, Apr. 1960, p. 156-161.

* **Estimating Human Radiation Exposure on the Animas River.** Reports on recent comprehensive studies of radioactive pollution of the Animas River by refinery wastes of U ore. ***Ernest C. Tsivoglou, S. David Shearer, Jr., John D. Jones, and Don A. Clark.*** *American Water Works Association, Journal*, v. 52, Oct. 1960, p. 1271-1290.

Laboratory Scale Activated Sludge Unit. Describes a unit which provides a fairly constant biological system based on organic removal efficiency and sludge activity. A recirculation of sludge allows a higher population to exist than the energy source would otherwise permit. ***Anthony F. Gaudy, Jr., Richard S. Engelbrecht, and Ralph D. De Moss.*** *Applied Microbiology*, v. 8, no. 5, Sept. 1960, p. 298-305.

* **Liquid Industrial Wastes. I-VIII.** A broad discussion of such materials and their treatment. ***C. Fred Gurnham.*** *Industrial Water & Wastes*, v. 5, no. 5, Oct. 1960, p. 121-164.

RELIABILITY ENGINEERING

Research and Development Aspects of Reliability. The reliability starts with the lowest component, and the way of progress starts there also. If reliability is not brought in at the research and development phase of any system, it will probably never be an operational usable one. ***J. T. Hayward.*** *IRE Transactions on Reliability and Quality Control,* v. RQC-9, Sept. 1960, p. 1-2. (TK1 In6.6q Vis.)

Availability—A System Function. Operational reliability, maintenance reliability, maintainability, and availability are discussed. Diagrams are cited. ***Robert P. Bielka.*** *IRE Transactions on Reliability and Quality Control,* v. RQC-9, Sept. 1960, p. 38-42. (TK1 In6.6q Vis.)

Reliability Responsibilities. The problem is discussed from many view points. The reliability in the production of all responsible workers is necessary. ***Julian K. Sprague.*** *IRE Transactions on Reliability and Quality Control,* v. RQC-9, Sept. 1960, p. 3-5. (TK1 In6.6q Vis.)

Statistical Approach to Reliability Improvement of the Tantalum Capacitor. The improvement of in-process rejections and the life-testing program are discussed. ***Nicholas P. Demos.*** *IRE Transactions on Reliability and Quality Control,* v. RQC-9, Sept. 1960, p. 29-33. (TK1 In6.6q Vis.)

The Motorola "Golden M" Tube Reliability Program. Characteristics tests, blast tests, accelerated-life tests, and visual analysis are discussed. ***J. Richard Belleville.*** *IRE Transactions on Reliability and Quality Control,* v. RQC-9, Sept. 1960, p. 34-37. (TK1 In6.6q Vis.)

A System Reliability Analysis. The above analysis provides a quantitative system reliability figure of merit based on per cent down-time weighted by degradation in system effectiveness. The analysis is a simple extension of common failure rate summations. The figure of merit, Σ rqd, allows individual reliability considerations to be intelligently compared with various other trade-off factors. ***R. T. Loewe.*** *IRE Transactions on Reliability and Quality Control,* v. RQC-9, Sept. 1960, p. 6-10. (TK1 In6.6q Vis.)

Aspects of Reliability in Transistorized Home Radios. Transistors should not be operated in excess of their limitations. The circuit must be designed so as to minimize the performance variation observed with limit transistors. ***John J. Corning.*** *IRE Transactions on Reliability and Quality Control,* v. RQC-9, Sept. 1960, p. 23-28. (TK1 In6.6q Vis.)

The Reliability of Transistors in Battery Portable Radio Receivers. Many aspects of this problem will require the continued mutual efforts of transistor manufacturers and equipment manufacturers to effect better standardization and interchangeability through EIA functions. It is clearly evident that the transistorization of battery portable receivers has resulted in a new and dramatically improved level of product reliability. ***Robert M. Cohen.*** *IRE Transactions on Reliability and Quality Control,* v. RQC-9, Sept. 1960, p. 11-16. (TK1 In6.6q Vis.)

* **Reliability Planning in Space Systems.** Proposes that none of the surveyed techniques has proved sufficiently effective to warrant their employment in future systems. A method is proposed which utilizes design analysis techniques rather than mathematical models to establish design goals. ***Vernon L. Grose.*** *Missile Design & Development,* v. 6, Sept. 1960, p. 20 + 4 pages.

RUBBER AND ELASTOMERS

* **Low Durometer Cast Urethane Elastomers.** Cast urethane elastomers exhibiting hardness values below 60 on the Shore A-2 scale. Usually prepared with the 80-20 isomer ratio of tolylene diisocyanate (TDI), these elastomers are quite distinct from the harder types of normally containing p,p'-diphenylmethane diisocyanate (MDI), 1,5-naphthalene diisocyanate (NDI) or, in rare cases, TDI. Typical values for the hard and soft cast urethanes are compared. ***H. L. Heiss.*** *Rubber Age,* v. 88, no. 1, Oct. 1960, p. 89-97.

New Additives Cut Vulcanization Costs. Commercial debut of a prill form of Delac-S, a delayed-action rubber accelerator. *Chemical Week,* v. 87, no. 15, Oct. 8, 1960, p. 91 + 3 pages.

* **Aspects of Rubber-Textile Adhesion.** Changes in adhesion, which take place as resorcinol-formaldehyde-latex adhesives are matured, are related to the change in the reactivity of the resin formed in aqueous solutions of the same initial reagent concentration as the adhesives. It is concluded that a reaction between the resin and the latex polymer does not take place during the preparation of the adhesive. ***G. M. Doyle.*** *Institution of the Rubber Industry, Transactions,* v. 36, no. 4, Aug. 1960, p. 177-194.

The Radiation Induced *cis-trans* Isomerization of Polybutadiene. III. Gamma-ray induced isomerization in solution and in the solid state, in the absence of any deliberately added sensitizer was studied. G_0 values for the *cis*→*trans* reaction, in the solid-state case, are about 1.2 to 14.6, respectively. ***Morton A. Golub.*** *American Chemical Society, Journal,* v. 82, Oct. 5, 1960, p. 5093-5098.

* **Infrared Spectroscopic Studies of Ultrathin Microtomed Sections of Polymers. I. Characterization and Structure Determinations of Cured, Black-Loaded Rubbers.** ***P. J. Corish.*** *Journal of Applied Polymer Science,* v. 4, no. 10, July-Aug. 1960, p. 86-91.

* **Rubber-Based Adhesives.** Conditions are dealt with which must be observed in the preparation of adhesive bonds. These are followed by a description of bonding methods and considerations on bonding errors and their suppression detailed account on "hard rubber material white" and "contact adhesive NO2/100". (*In German.*) *Klebstoffe auf Gummibasis.* ***H. Diehl.*** *Plaste und Kautschuk,* v. 7, Sept. 1960, p. 432-434.

* **Use of the Red Clay 100 T. L. Masterbatch for Various Applications.** The compounds made from this masterbatch were compared to conventional carbon black or reinforcing clay compounds for the following uses: soles, treads, shock-absorbers and belts. The mechanical properties are of the same order as with high-grade carbon-blacks. The vulcanizates are very resilient with a low heat buildup and excellent resistance to repeated bending. (*In French.*) Emploi du mélange-maitre d'argile rouge 100 T.L. dans diverses applications. ***Cl. Thélamon.*** *Revue générale du Caoutchouc,* v. 37, Sept. 1960, p. 1127 + 6 pages.

* **Foaming Capacity of Rubber Latex.** In the production of air foams from SKS butadiene-styrene rubber latex, the foaming capacity of the latter is characterized by the product of the foam volume and the time from formation of the foam until its destruction. The decisive factor in the stability of such foams from a concentrated latex is the viscosity of the latex. In a more dilute latex (25-30%) the foaming capacity is determined first of all by the surface tension, increasing with decrease of the latter. ***D. M. Sandomirskii and A. A. Korotkova.*** *Rubber Journal and International Plastics,* v. 139, no. 12, Sept. 17, 1960, p. 415-416.

* **Interaction of Sulfur and Natural Rubber by the Action of Ionizing Radiation.** The effect of S on the kinetics of the radiation structuration of natural rubber and the properties of the radiation vulcanizates was investigated. The presence of S diminishes the effect of structuration. Increase in temperature during the irradiation from —80 to 100 C causes an intensification in the structuration. With pure rubber at temperatures above 50 C reversion of the structuration process takes place; in the presence of S, this phenomenon is not observed. On irradiating natural rubber and its mixtures with S in Ar, a significant fall in unsaturation is observed, the fall being less marked in the presence of S. (*In Russian.*) Vzaimodeĭstvie sery s natural'nym kauchukom pod deĭstviem ioniziruiushchikh izlucheniĭ. ***Z. N. Tarasova, M. Ia. Kaplunov, V. T. Kozlov, N. A. Klauzen, and B. A. Dogadkin.*** *Vysokomolekuliarnye Soedineniia,* v. 2, no. 8, Aug. 1960, p. 1201-1206.

SPACE HEATING AND CONDITIONING

*** Successful Radiant Heating With Thermoplastic Pipe.** *Air Conditioning, Heating and Ventilating,* v. 57, Oct. 1960, p. 99-100.

*** Selecting Air Conditioning Systems for Specific Applications.** Tables prepared on the evaluation of systems according to functions performed by the systems and the type of application are used to select a system that shows the best economy for a specific application. ***Maurice J. Wilson.*** *Air Conditioning, Heating and Ventilating,* v. 57, Oct. 1960, p. 72-74.

A Simplified Procedure for Calculation of Residential Cooling Loads. Information on heat gains and data on cooling loads compiled from five research houses at the University of Illinois provided the basis for the proposed cooling load calculating procedure which approximated the measured maximum loads in each of the houses. ***W. S. Harris and E. J. Brown.*** *ASHRAE Journal,* v. 2, Oct. 1960, p. 43 + 8 pages.

X-Y Recorder Programs Tapered-Sheet Welding on B-70. Almost every aspect of the B-70 design program calls for advances beyond the present state of the art in manned vehicles. NAA had to know, for instance, which weld variables to program for tapered-sheet fusion welds. The only way to get this information, it found, was to run its own study. *Space/Aeronautics,* v. 34, no. 4, Oct. 1960, p. 167 + 4 pages.

It Is Possible to Create Artificial Gravity and Use Refrigerating Equipment for the Cooling of Space Cabins. ***R. S. Taylor.*** *ASHRAE Journal,* v. 2, Oct. 1960, p. 50-52.

*** Guide to...Industrial Ventilation in the Chemical Industry.** Explains mechanical exhaust ventilation for control of gases, mists, and vapors liberated during filtration. Points highlighted include employee exposure, hood enclosure design, and filter types. ***William V. Andresen.*** *Air Engineering,* v. 2 ,no. 10, Oct. 1960, p. 37 + 3 pages.

*** Engineering Fundamentals of Air Sanitation With Ultraviolet Light. I.** A practical engineering guide on application of ultraviolet light for air sanitation in schoolrooms, bakeries, pharmaceutical plants, meat packing, wherever air should be sterile. ***J. C. Hoffman.*** *Air Engineering,* v. 2, no. 10, Oct. 1960, p. 30-36.

Building Design Trend Paves the Way for Integrated Lighting, Cooling. With the trend in modern building design toward ever larger external glass areas (and consequent solar heat gain) and higher internal lighting levels (radiation), the design of economical cooling and heating systems for these structures is growing more and more complicated. One way to cope with the increased cooling loads imposed by this movement is by integrated lighting—air conditioning. ***Will S. Fisher and John E. Flynn.*** *Heating, Piping & Air Conditioning,* v. 32, Oct. 1960, p. 113-117.

*** Improved Plant Environment by the Use of Make-Up Air.** An attempt was made to describe why many heating systems fail to provide satisfactory environmental conditions in an industrial plant. Methods of providing improved environment throughout the year with the same equipment were discussed. ***K. E. Robinson.*** *Canadian Mining Journal,* v. 81, Sept. 1960, p. 114-118.

*** A New Departure in Electric Heating.** The supremacy of the metallic resistance element in one form or another as a means of converting electricity into heat and light has remained unchallenged since the C filaments of Edison and Swan were superseded by the W filament at the beginning of this century. However, in the field of electric heating the wheel of progress has now been turned full circle by the adoption of C as the resistance medium for a new non-metallic area heating element developed by a British firm. ***A. H. S. Lucas.*** *Institution of Heating and Ventilating Engineers,* v. 28, Sept. 1960, p. 211-214.

*** Acoustical Design of Ventilating Systems. I.** The ventilating engineer may need to make some assessment of the noise characteristics of a ventilating system at the design stage, in order to decide upon measures to provide acceptably quiet operation. A survey of existing information on the subject was made; and some suggestions are put forward for making this assessment. ***D. R. Johnson.*** *Institution of Heating and Ventilating Engineers,* v. 28, Sept. 1960, p. 197-210.

TEXTILES, FIBERS, LEATHER, AND PAPER

*** Cotton Quality Study. V. Resistance to Abrasion.** ***John P. McNally and Frank A. McCord.*** *Textile Research Journal,* v. 30, Oct. 1960, p. 715-751.

*** The Depolymerization of Collagen Fibers.** The ultracentrifuge studies showed that the depolymerization of the intact fiber did not yield a gaussian weight distribution of gelatin. Several discrete molecular weight species were obtained. ***Arthur Veis, Joan Anesey, and Jerome Cohen.*** *American Leather Chemists Association, Journal,* v. 55, Oct. 1960, p. 548-563.

*** The Temperature Dependence of the Breaking of Hydrogen Bonds of Collagen by Urea and Some of Its Implications.** The solubilization of hide collagen by concentrated solutions of urea (4-8*M*) is highly temperature-dependent. These solutions do not degrade collagen appreciably at temperatures less than 30 C. Another most effective H bond breaker of collagen, sodium perchlorate, is highly dependent on concentration. Thus, solutions weaker than 2*M* attack collagen only slightly at room temperature. ***K. H. Gustavson.*** *American Leather Chemists Association, Journal,* v. 55, Oct. 1960, p. 564-584.

*** Research on Wood Finishes.** Describes the nature of technological improvements which have been made in wood finishes for exterior use, floors, furniture, and marine applications. Discusses means which are potentially suitable for making further improvements. ***B. G. Brand, L. J. Nowacki, and H. N. Johnston.*** *Forest Products Journal,* v. 10, July 1960, p. 329-333.

*** Study of Molecular Structure of Fibres.** Fibrous structures are invariably formed out of long molecular chains, which occur, in particular, in high polymers. Practically all fibers have a helical structure. ***G. N. Ramachandran and V. Sasisekharan.*** *Journal of Scientific & Industrial Research,* v. 19A, Aug. 1960, p. 357-366.

*** The Urgent Need for More Facts and for a More Critical Approach in Assessing Papermaking Data.** Attention is drawn to the opportunities in the paper industry for seeking more facts from which to bring about worthwhile technological advances. By reference to examples drawn mainly from groundwood manufacture, wet end problems, drying, and the testing of finished products, it is contended that, too often, essential information is lacking, the limitations of existing data are not fully appreciated, and false scents lead to erroneous conclusions. ***G. F. Underhay.*** *Paperi ja Puu,* v. 42, no. 8, Aug. 1960, p. 419 + 11 pages.

*** Aspen Wood Constituents.** ***S. E. Larsson and Lars Seilely.*** *Svensk Papperstidning,* v. 63, no. 18, Sept. 30, 1960, p. 606-608.

*** Radioactive Sources and Tracers in Pulp and Paper Technology.** The absorption of the radiation from radioactive sources furnishes information on the area weight of sheet materials, liquid levels in closed containers, the density of flowing liquids, etc. Radioactive tracers have proved to be very valuable in studying such problems as flow measurements of pulp and water, circulation in cellulose digesters, flow in bleaching towers, and chip transport in continuously operating digesters. (*In Swedish.*) Radioaktiva strålkällor och spårämnen i cellulosa- och pappersteknikеn. ***Knut Ljunggren.*** *Svensk Papperstidning,* v. 63, no. 18, Sept. 30, 1960, p. 609-618.

*** Relative Toxicity of Biostatic Agents Suggested for Use in the Pulp and Paper Industry, 1958 Review.** The inhibiting concentration of the test materials was determined for two species of bacteria (*Aerobacter aerogenes, Bacillus mycoides*) and two species of fungi (*Aspergillus niger, Penicillum expansum*). It is suggested that for a more critical evalua-

tion of a compound's merits the material should be tested under conditions which more closely approximate those of actual use. ***J. H. Conkey and J. A. Carlson.*** *Tappi*, v. 43, Oct. 1960, p. 12A + 7 pages.

* **Relative Toxicity of Biostatic Agents Suggested for Use in the Pulp and Paper Industry, 1959 Supplement.** Thirty-three materials and four test organisms were used. ***J. H. Conkey and J. A. Carlson.*** *Tappi*, v. 43, Oct. 1960, p. 40A + 1 page.

* **Studies on the Mechanism of Wet Strength Development. II.** Studies are presented on the general characteristics of urea-formaldehyde resin-treated papers and on the rate of loss of wet strength of these papers when immersed in distilled water at various temperatures. Model compound studies indicate that cellulose hydroxyls do not form chemical linkages with the polymerized UF-resin. ***A. Jurecic, C. M. Hou, K. Sarkanen, C. P. Donofrio, and V. Stannett.*** *Tappi*, v. 43, Oct. 1960, p. 861-865.

The Sorption of Water by Cellulose and Eight Other Textile Polymers. Detailed results are presented on the equilibrium absorption and desorption of water vapor by various celluloses in the range 0-100% r.h. and 3-90 C. Stabilization causes a marked decrease in the sorptivity of the regenerated, bacterial, and animal celluloses. ***R. Jeffries.*** *Textile Institute, Journal, Transactions*, v. 51, Sept. 1960, p. T339-T374.

* **Relationship Between Fiber Properties and Fabric Wrinkle Recovery.** For a variety of fibers, a one-to-one correspondence was found between fabric crease-angle recovery and a modified tensile recovery parameter, i.e., the average value of tensile recovery measured against a restraining force related to the coefficient of interfiber friction. Results indicate that the predominant fiber properties controlling fabric recovery can be determined without recourse to a complete mathematical treatment. ***W. W. Daniels.*** *Textile Research Journal*, v. 30, Sept. 1960, p. 656-661.

* **Some Principles of Nonwoven Fabrics.** Outlines the principal mechanisms by which woven cloths deform and recover in manufacture and in end usage. Fiber behavior measured on the Instron provide the material constants necessary for insertion in derived analytical expressions for nonwoven fabric stiffness and contraction ratios. ***Stanley Backer and Dewitt R. Petterson.*** *Textile Research Journal*, v. 30, Sept. 1960, p. 704-711.

WELDING AND JOINING

Welding of Precipitation-Hardening Corrosion-Resisting Steels. The low C martensitic type and semi-austenitic type of precipitation-hardening stainless steels in the form of bar, centri-die spun castings, and sheet are described. Their compositions, heat-treatment, physical and mechanical properties, and weldability by metal-arc, argonarc, inert-gas metal-arc, and resistance welding processes are dealt with. The mechanical properties of various welds and the effect of post-weld heat-treatments are given. The application of these steels has solved a number of engineering problems. ***J. I. Morley and J. A. McWilliam.*** *British Welding Journal*, v. 7, Oct. 1960, p. 651-658.

High-Frequency Induction Brazing of Small Components in Argon Streams. Some experiments on the use of high-frequency induction brazing in Ar streams for joining small components in similar and dissimilar metals are outlined. It is shown that filler metals are available for the successful joining of a range of material combinations. The technique is particularly valuable for joining parts made from non-film forming materials, although the latter may be successfully brazed if preplating is employed. ***P. M. Bartle and J. G. Young.*** *British Welding Journal*, v. 7, Oct. 1960, p. 638-642.

Cracking Tests for Assessing Weldability. Reviews the many types of cracking tests that have been devised to assess weldability, and discusses their characteristics and limitations. Details of each test described are given in an appendix, and there is an extensive bibliography. ***J. C. Borland.*** *British Welding Journal*, v. 7, Oct. 1960, p. 623-637.

Welding Problems Associated With Nuclear Fuel Elements. Considers the problems associated with the development of welding techniques for sealing present and future elements to a stage where an automatic process can be used on a production scale. The end seal is not the only application of welding in fuel-element manufacture, as attachments and supports, or the fuel itself, also demand welds of high integrity. ***A. F. Taylor.*** *British Welding Journal*, v. 7, Oct. 1960, p. 615-622.

Whither Electrode Design? Considers the reactions in the welding arc and some of the problems of measuring them. Progress in the design of alloy steel electrodes is considered. The problems of moisture pick-up by low H electrode coatings and future developments of electrodes with coatings loaded with alloys and Fe powder are discussed. ***I. C. Fitch.*** *British Welding Journal*, v. 7, Oct. 1960, p. 600-604.

Distribution of Phosphorus and Sulphur in Fully Austenitic Stainless Steel Welds. Small additions of radioactive S and P were made to a 24% Cr-21% Ni stainless steel, which was fabricated into thin sheet. Welds were examined by autoradiography and metallography. The concentration of P in the middle of the weld zone was measurably greater than in the original sheet. This concentration resulted from depletion of the first metal to solidify along the sides of the weld. Phosphorus was also found to concentrate in the interdendritic regions of a casting of a basically similar steel. Phosphorus, therefore, is important in the hot-cracking of fully austenitic stainless steel welds. Sulphur, however, was not concentrated preferentially in the weld metal, and it was concluded that S is not important in the formation of cracks observed in these welds. ***S. M. Makin, C. B. Alcock, D. R. Arkell, and P. C. L. Pfeil.*** *British Welding Journal*, v. 7, Oct. 1960, p. 595-599.

Welding Metallurgy of the Nimonic Alloys. The constitution and physical properties of alloys of the Nimonic and Nimocast series are discussed in relation to their influence on welding characteristics. Effects of the solution and precipitation-hardening heat-treatments used to develop optimum high-temperature properties are correlated with the behavior of the respective materials under the thermal conditions imposed by welding. The mechanical properties of the parent metals and of the welded joints are described, with particular reference to the effects of the various temperatures attained by the weld itself and by adjacent heat-affected zones. Welding procedures are recommended for both wrought and cast nickel-base high-temperature alloys. Brazing techniques and materials are also considered, including the possibility of combining the brazing operation with thermal hardening treatments required for certain alloys. ***J. Hinde and D. R. Thorneycroft.*** *British Welding Journal*, v. 7, Oct. 1960, p. 605-614.

Allowable Stresses in Flash-Welded Joints. How to correlate fatigue data with magnetic inspection to give practical values. ***Herbert L. Kee.*** *Product Engineering*, v. 31, no. 45, Oct. 31, 1960, p. 39-42.

* **Metal Arc Welding of Aluminum.** Metal arc is faster, causes less distortion, and requires less edge preparation than oxy-gas welding. *Modern Metals*, v. 16, no. 9, Oct. 1960, p. 72 + 1 page.

Manual for Plastic Welding. Polyvinyl Chloride. A complete manual on the history and technology of PVC in general and on PVC welding in particular. ***G. Haim.*** v. III. 324 pp. 1960. Chemical Publishing Co., New York. (TP986 H12w)

* **Welding Aluminum. VI. Oxy-Gas and Metal Arc Welding.** Covers two welding methods—oxy-gas and manual metal arc. Discussion in both sections includes principles of operation, joint spacing, flame selection and technique. *Modern Metals*, v. 16, no. 9, Oct. 1960, p. 66 + 2 pages.

* **Aluminum Can Now Be MIG Spot Welded.** Metal-inert-gas spot welding has been successfully adapted to Al. Olin laboratories did the job; devised method of producing consistent cone-shaped welds. Equipment used for normal MIG welding can be inexpensively altered for spot process. ***I. A. MacArthur and A. A. Dolomont.*** *Modern Metals*, v. 16, no. 9, Oct. 1960, p. 52 + 2 pages.

* **Electroslag Weld Quality Under Various Treatment Conditions.** Unalloyed electroslag welds in untreated situations are

characterized by resistance to hot tears, and to fissure from tempering, slag inclusions, pores; by coarse grain structure, by a wide transformation zone (about 15 mm), by favorable stress conditions due to solidification and cooling. Normalizing refines the grain and eliminates the conversion zone, thus increasing the slag strength. Below 40 mm, normalization can be carried out locally by continuous induction heating. (*In Swedish.*) Elektroslaggsvetsars kvalitet i olika behandlingstillstånd. ***Ian Wachtmeister.*** *Svetsaren*, v. 25, no. 2, 1960, p. 25-39.

Vapor-Shielded Arc Means Faster Welding. Vaporization of metal oxides and salts carried in a cored-wire electrode provides a shield for the arc in a new welding technique. High operating current and a fast-follow arc characteristic aid in getting welding speeds up to 200 in. per min. ***R. A. Wilson.*** *Metal Progress*, v. 78, no. 4, Oct. 1960, p. 96-100.

* **What We Now Know About Electron Beam Welding.** Has the electron beam-welding process been oversold, or does this joining method really have a future? Here's what one manufacturer of electron beam welders thinks. ***David N. Reece.*** *Welding Design & Fabrication*, v. 33, Oct. 1960, p. 52 + 2 pages.

* **Welding Plays Key Role in Fabricating Longest Zirconium Tubes Ever Made.** Three companies pooled their welding and fabricating know-how to produce Zr tubes to hold a nuclear reactor's fuel elements. *Welding Design & Fabrication*, v. 33, Oct. 1960, p. 54-55.

Recent Developments in Oxy-Fuel-Gas Cutting. Discusses the proper use of propane or natural gas and the selection of suitable equipment. ***C. C. Anthes.*** *Welding Journal*, v. 39, Oct. 1960, p. 1022-1027.

Machine Welding of a Prepackaged Liquid Rocket Engine. Describes successful quality output of new family of thrust units. ***Ralph L. Hoetger and Walter B. Moen.*** *Welding Journal*, v. 39, Oct. 1960, p. 1028-1036.

Studies of Methods for Sealing Ends of Reactor Fuel Rods for PWR. As part of the WAPD program for developing fuel rods for PWR, methods for sealing the ends of Zircaloy 2-clad, U-12 w/o Mo-cored fuel rods made by coextrusion were investigated. Attempts were made to join Zircaloy 2 end plugs to the rod by means of pressure bonding, resistance welding, and fusion welding. Exploratory tests indicated that resistance upset welding was promising. Tension-test fractures occurred in the Zircaloy 2 end caps away from the weld joint when materials were vacuum treated prior to upset welding. Percussion welding and flash welding were eliminated from extensive consideration because molten core alloy was extruded out along the cladding-to-end-cap bond line when these processes were used. Attempts to fusion weld an overlay on the ends of the fuel rods resulted in end seals that had U at the surface and also contained gas porosity. ***J. J. Vagi and D. C. Martin.*** *Welding Journal*, v. 39, Oct. 1960, p. 443s-448s.

Strength of Welded Aluminum-Alloy Box Beams. Bending tests demonstrate that welded aluminum-alloy box beams have good strength and ductility. Proposed design methods are shown to give satisfactory values of bending ultimate and yield strengths. ***R. J. Brungraber.*** *Welding Journal*, v. 39, Oct. 1960, p. 417s-423s.

"Expanding Bracelet" Backing Bar Simplifies Welding of Missile Shells. ***C. M. Jenkins.*** *Welding Journal*, v. 39, Oct. 1960, p. 1058-1059.

Short-Arc Consumable-Electrode Welding Applications and New Developments. Acceptance in automotive industry and in field of general metal fabrication points to its growing importance. ***T. McElrath.*** *Welding Journal*, v. 39, Oct. 1960, p. 1044-1050.

Stud Welding With a Silicon-Rectifier Power Source. A silicon-rectifier power source was developed specifically for stud welding. Large-diameter studs can be welded satisfactorily, using as much as 200 ft of welding cable. ***S. Baum.*** *Welding Journal*, v. 39, Oct. 1960, p. 1037-1042.

MISCELLANEOUS

a • * **On the Failure to Eliminate Hypotheses in a Conceptual Task.** Investigation examines the extent to which intelligent young adults seek confirming evidence alone (enumerative induction) or confirming and disconfirming evidence (eliminative induction), in order to draw conclusions in a simple conceptual task. ***P. C. Wason.*** *Quarterly Journal of Experimental Psychology*, v. 12, pt. 3, Aug. 1960, p. 129-140.

b • * **Correction for Bias Introduced by a Transformation of Variables.** Deduces minimum variance unbiased estimates of the effects of experimental treatments expressed in the original units. The solution is obtained for a broad category of transforming functions. ***Jerzy Neyman and Elizabeth L. Scott.*** *Annals of Mathematical Statistics*, v. 31, no. 3, Sept. 1960, p. 643-655.

c • * **Estimates With Prescribed Variance Based on Two-Stage Sampling.** A method is given which provides, under conditions satisfied by many common distributions, rules for sampling in two stages so as to obtain an unbiased estimator of a given parameter, having variance equal to, or not exceeding, a prescribed bound. ***Allan Birnbaum and William C. Healy, Jr.*** *Annals of Mathematical Statistics*, v. 31, no. 3, Sept. 1960, p. 662-676.

d • * **Probability Content of Regions Under Spherical Normal Distributions. I.** Attempts to lay the groundwork for a relatively well-rounded theory of the spherical normal distribution. ***Harold Ruben.*** *Annals of Mathematical Statistics*, v. 31, no. 3, Sept. 1960, p. 598-618.

e • * **Graphs for Bivariate Normal Probabilities.** Presents three charts, which will enable one to easily compute the bivariate normal integral to a maximum error of 10^{-2}. ***Marvin Zelen and Norman C. Severo.*** *Annals of Mathematical Statistics*, v. 31, no. 3, Sept. 1960, p. 619-624.

f • * **The Economics of New Roads With Particular Reference to Ml.** Treats building a new road as a problem in economic prediction, and describes methods of obtaining estimates of the data on which predictions can be based. ***T. K. Burdess.*** *Applied Statistics*, v. 9, no. 2, June 1960, p. 113-121.

g • * **Ergodocity of Queues in Series.** Determines when a queueing system consisting of several queues in series is ergodic. ***J. Sacks.*** *Annals of Mathematical Statistics*, v. 31, no. 3, Sept. 1960, p. 579-588.

h • * **Statistics and Taste Testing.** Deals with tests of discriminability and tests of preference, and discusses the question, whether the subject should be allowed to record ties, or should be compelled to give a definite vote even if he is not sure. ***Norman T. Gridgeman.*** *Applied Statistics*, v. 9, no. 2, June 1960, p. 103-112.

i • * **The Replacement and Expansion of Durable Equipment.** Considers the operation of a certain facility providing a service for a growing population, e.g., a power plant, a transportation system, a telephone system, transmission facilities between two points, etc. Assumes that the requirement for this service as a function of time is given, and that to meet the requirement the facility must expand and replace its equipment from time to time. Shows how the most economical policy can be determined. ***Frank W. Sinden.*** *Society for Industrial and Applied Mathematics, Journal*, v. 8, no. 3, Sept. 1960, p. 466-480.

j • * **Matrix Equations for the Determination of Beam Natural Frequencies.** A general matrix equation is developed by which it is possible to determine the frequencies and modes of a beam vibrating in coupled beam bending, beam shear and torsion, with the effects of mass, torsional moment of inertia and rotary moment of inertia included. ***Wilbur T. McKinney.*** *Society for Industrial and Applied Mathematics, Journal*, v. 8, no. 3, Sept. 1960, p. 436-457.

k • * **Algorithms for Chebyshev Approximations Using the Ratio of Linear Forms.** Describes some methods for obtaining from a special class of functions the best or Chebyshev approximation to a continuous function over a set of discrete points. ***Henry L. Loeb.*** *Society for Industrial and Applied Mathematics, Journal*, v. 8, no. 3, Sept. 1960, p. 458-465.